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A Study of Cognitive and Attitudinal Interactions in Seventh-Grade Mathematics.

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Guy W. Johnson
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ABSTRACT

The purpose of the study was to examine relationships among student, parent, and teacher attitudes toward mathematics, student perceptions of mathematics attitudes, and student class marks in mathematics. The study population consisted of seventh grade mathematics students in the public schools of East Baton Rouge Parish, Louisiana, during the 1975-76 school year. During the spring of 1976, Likert-type mathematics attitude scales constructed by the writer were submitted to a random sample of 364 seventh grade students, their parents, seventh grade mathematics teachers, and teachers of the previous year. In addition, students were requested to report perceptions of parent and teacher mathematics attitudes by completing a Feelings About Math scale constructed by the writer. Complete or partial data were provided by 145 students, their parents, and teachers.

Kuder-Richardson Formula 21 reliabilities of the study instruments ranged from .88 to .93. The correlation between student attitude scale scores and self ratings on Feelings About Math was .815.

The students of the sample did not differ significantly by sex with respect to mathematics attitudes or class marks. About half reported favorable mathematics attitudes, with 11 percent reporting strongly negative attitudes. The mean grade point average fell between B and C levels.

Among adult groups, seventh grade teachers reported the most positive mathematics attitudes, followed by sixth grade teachers,

fathers, and mothers, in that order. Mean student ratings of adult attitudes by group were in the same order, although students tended to underrate seventh grade teacher attitudes and overrate the attitudes of others.

Student ratings of parent attitudes were significantly related to parent attitude scale scores ($p < .01$). Correlations tended to be higher for ratings of the parent of opposite sex. Student ratings of teacher attitudes were not related to teacher attitude scale scores.

The correlation of attitude scale scores of students and mothers was positive and significant ($p < .05$). The correlation of attitude scale scores for girls and seventh grade teachers was negative and approached significance ($p < .10$).

Student sex, attitude scale scores for parents and teachers, and second order interactions of these scores were not significant predictors of the mathematics attitudes of students for whom complete attitude data were available ($n = 70$). These students were primarily those from two parent homes and tended to have high grade point averages in mathematics. For a larger part of the sample ($n = 130$), the multiple correlation of student attitude with student sex, attitude scores for mothers and seventh grade teachers, and their interaction approached significance ($p < .10$).

Student sex, student ratings of parent and teacher attitudes, and the second order interactions of these ratings were not significant predictors of student attitudes. Student self ratings in mathematics attitudes, however, were significantly related to student ratings of the attitudes of each parent and the seventh grade teacher ($p < .01$). Correlations were highest between self ratings and ratings for the parent of

the same sex. The number of adult ratings above the median was significantly related to self ratings ($p < .01$).

Mathematics grades were significantly related to student attitude scale scores ($p < .01$). Simple correlations between mathematics grades and parent and teacher attitudes were not significant. About 53.0 percent of the variance in grades, however, was accounted for by student sex, attitude scale scores of students, parents, teachers, and second order interactions.

A similar pattern was observed in the relationship of grades and student ratings of attitudes. Student sex, student ratings of attitude, and second order interactions accounted for 34.1 percent of variance in grades.

Chapter 1

INTRODUCTION

Many factors, affective as well as cognitive, influence a student's success in mathematics school work. Neale (1969) found that, for the sixth grade boys of his study, 70.4 percent of the variance from pretest to posttest scores could be attributed to prior mathematics achievement, 40.5 percent to intelligence quotient scores, and 12.5 percent to student attitudes toward mathematics.

The relation of affective criteria such as attitudes to student achievement in mathematics has been considered by many researchers. On the basis of case studies with college students, Poffenberger and Norton (1956) hypothesized that children derive positive and negative attitudes to mathematics from their parents; that parental expectations affect student achievement in mathematics; and that mathematics teachers can exert a positive influence on student attitudes and achievement through the attitudes they display and the classroom climate they maintain.

A number of studies have tested hypotheses similar to these, with results which have frequently been in conflict. Whipkey (1970) noted "a small but important relationship between mathematical attitude and mathematical achievement" among prospective elementary school teachers. Keane (1969) reported inconclusive results regarding the relationship of teacher attitudes toward mathematics and the attitudes of elementary school children. The results of Deighan (1971) indicated a small relationship between student attitudes toward mathematics and

student achievement in mathematics but no significant relation between student and teacher attitudes for elementary school children. Phillips (1973), working with seventh grade students, found a significant relationship between student attitudes toward mathematics and the attitude of the most recent teacher. No significant relationship between the most recent teacher's attitude and student achievement was found by Phillips, but, when he extended his analysis to include the mathematics attitudes of the student's three previous teachers, he noted significant relationships between both student attitudes and achievement and the type of teacher attitude for two out of three of the previous three years.

In a study of relationships among parent attitudes toward mathematics, student attitudes toward mathematics, and student achievement in mathematics, Burbank (1968) reported significant correlations between mother's attitude and student attitude, father's attitude and student achievement, and student attitude and achievement. Levine (1973) found that student achievement level played a significant role in the ability of upper elementary students and their mothers to perceive each other's attitudes toward mathematics.

The purpose of the present study was to examine relationships of student, teacher, and parent attitudes toward mathematics, student perceptions of these attitudes, and student success in seventh grade mathematics work as measured by class marks. Attention was given to the interactions of teacher and parent attitudes and the effects of these interactions on student attitudes and scholastic success.

STATEMENT OF THE PROBLEM

With respect to the seventh grade students participating in the study, answers to three groups of questions were sought. The first group of questions pertained to the relationships between scale measured attitudes toward mathematics and student perceptions of these attitudes. Questions of the second group dealt with the joint effect of teacher and parent attitudes toward mathematics on student attitudes toward mathematics. The third group of questions had to do with the relation of student, teacher, and parent attitudes and the interactions of these attitudes to student success in seventh grade mathematics. For all questions treated, the effects of sex differences on the variables involved were considered.

Questions of the first group were stated as follows:

1. Is student perception of student attitude toward mathematics significantly related to scale measured student attitude toward mathematics? Does this relationship vary significantly with respect to student differences in sex?

2. Is student perception of the attitude toward mathematics of the seventh grade mathematics teacher significantly related to the seventh grade mathematics teacher's scale measured attitude toward mathematics? Does this relationship vary significantly with respect to student differences in sex?

3. Is student perception of the attitude toward mathematics of the sixth grade teacher significantly related to the sixth grade teacher's scale measured attitude toward mathematics? Does this relationship vary significantly with respect to student differences in sex?

4. Is student perception of the mother's attitude toward mathematics significantly related to the mother's scale measured attitude toward mathematics? Does this relationship vary significantly with respect to student differences in sex?

5. Is student perception of the father's attitude toward mathematics significantly related to the father's scale measured attitude toward mathematics? Does this relationship vary significantly with respect to student differences in sex?

Questions of the second group were stated as follows:

6. Is scale measured student attitude toward mathematics significantly related to the scale measured attitudes toward mathematics of the student's mother, father, seventh grade mathematics teacher, and sixth grade teacher? Is scale measured student attitude toward mathematics significantly related to the interactions of scale measured attitudes toward mathematics of mother, father, seventh grade teacher, and sixth grade teacher? Do the relationships vary significantly with respect to student differences in sex?

7. Is scale measured student attitude toward mathematics significantly related to student perceptions of the attitudes toward mathematics of the student's mother, father, seventh grade mathematics teacher, and sixth grade teacher? Is scale measured student attitude toward mathematics significantly related to the interactions of student perceptions of the attitudes toward mathematics of mother, father, seventh grade mathematics teacher, and sixth grade teacher? Do these relationships vary significantly with respect to student differences in sex?

Questions of the third group were stated as follows:

8. Is student success in seventh grade mathematics significantly related to scale measured attitudes of the student, his mother, father, seventh grade mathematics teacher, and sixth grade teacher? Is student success in seventh grade mathematics significantly related to the interactions of scale measured attitudes toward mathematics of the student, his mother, father, seventh grade mathematics teacher, and sixth grade teacher? Do these relationships vary significantly with respect to student differences in sex?

9. Is student success in seventh grade mathematics significantly related to student perceptions of the attitudes toward mathematics of the student, his mother, father, seventh grade mathematics teacher, and sixth grade teacher? Is student success in seventh grade mathematics significantly related to the interactions of student perceptions of the attitudes toward mathematics of the student, his mother, father, seventh grade mathematics teacher, and sixth grade teacher? Do these relationships vary with respect to student differences in sex?

DEFINITION OF TERMS

Success in mathematics, in the context of the present study, was measured by the sum of accumulated grade points earned in seventh grade mathematics by participating students during the first three grade periods of the 1975-1976 school year. A grade of A for one period represented 4 grade points; a B, 3; etc. Each grade period covered nine weeks.

Attitude toward mathematics was regarded as an individual's favorable or unfavorable feeling toward mathematics, measured on a one

dimensional scale ranging from enthusiasm to aversion. Measures of mathematics attitudes were obtained from Likert-type attitude scales constructed by the writer.

The perception of attitude was a subjective evaluation of attitudes toward mathematics through the assessment of observed behaviors and preferences. A questionnaire constructed by the writer provided measures of student perceptions of mathematics attitudes.

DELIMITATIONS OF THE STUDY

The study was carried out in the public schools of East Baton Rouge Parish, Louisiana, during the 1975-1976 school year. Students of seventh grade mathematics in the public junior high schools and middle schools of the parish constituted the student population for the study. From a total of approximately 5,723 students, 364 were chosen at random. The instruments of the study were submitted to these students, their parents, their seventh grade mathematics teachers, and their sixth grade teachers. The final study sample consisted of 145 students for whom all or part of the required data were available.

IMPORTANCE OF THE STUDY

The relation of teacher attitude toward mathematics to student attitude and achievement in mathematics has been considered in several studies. Other studies have dealt with the relation of parental attitudes to student achievement in mathematics. The present study provided a more comprehensive view of the relations of mathematics attitudes and achievement and contributed to the literature an examination of the joint effects of teacher and parent attitudes on student attitude and

success in mathematics. In addition, the study contributed a consideration of the relation of student perceptions of teacher and parent attitudes to scale measured mathematics attitudes of teachers and parents, to student mathematics attitudes, and to student success in mathematics.

SOURCE AND TREATMENT OF THE DATA

Instruments to provide mathematics attitude data for students, parents, and teachers and student perceptions of these attitudes were constructed and tested by the writer. The instruments consisted of a 12-item Likert-type mathematics attitude scale for adults, a similar mathematics attitude scale for students, and the Feelings About Math scale for students, designed to obtain data concerning student perceptions of parent and teacher mathematics attitudes.

Randomly chosen seventh grade mathematics students in East Baton Rouge Parish, Louisiana, public schools were invited to participate in the study. Copies of adult and student instruments were forwarded to the parents of the students selected. Each parent was requested to complete the adult mathematics attitude scale, to supervise the completion of student questionnaires, and to grant the writer permission to examine the student's school records. Completed forms were returned to the writer by mail.

School and parish records were employed to provide mathematics grades for participating students and to identify their seventh grade mathematics and sixth grade teachers. Mathematics attitude scales were submitted to the teachers identified. Teacher responses were returned to the writer by mail.

To obtain answers to the questions of the study, pertinent correlation coefficients, coefficients of contingency, and multiple regressions were computed. Statistical findings were summarized in tabular form and analyzed.

Chapter 2

A REVIEW OF RELATED LITERATURE

The review of the literature concerning mathematics attitudes and their relationship to student success in mathematics focused on the following topics:

characteristics of attitudes;

methods of measuring attitudes;

student attitudes toward mathematics;

teacher attitudes toward mathematics and their relation to student attitudes;

parent attitudes toward mathematics and their relation to student attitudes;

the relation of mathematics attitudes to student success of achievement in mathematics.

CHARACTERISTICS OF ATTITUDES

L. L. Thurstone, a pioneer in attitude research, defined "attitude" (Thurstone and Chave, 1929:6-7) as

> the sum-total of a man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats and convictions about any specific topic.

Shaw and Wright (1967:7) emphasized that attitudes vary "in quality and intensity on a continuum from positive through neutral to negative." Further, although attitudes are fairly stable, they are learned and hence subject to change (Shaw and Wright, 1967:8,9).

Much productive research has dealt with attitude toward mathematics as a variable on a single continuum. Most instruments designed to measure mathematics attitudes provide a single overall attitude score. Aiken (1970), however, advocated a multidimensional approach to the study of mathematics attitudes. Sandman (1973), working with eighth and eleventh graders, identified six factors contributing to overall attitude toward mathematics. These factors were perception of mathematics teachers, anxiety toward mathematics, appreciation of the value or usefulness of mathematics, mathematics self-concept, enjoyment of mathematics, and motivation in mathematics. Burek (1975) identified three factors in an attitude measure used with sixth and eighth graders. The factors were labeled confidence-enjoyment, guarded interest, and knowledge of incompetence.

METHODS OF MEASURING ATTITUDES

Corcoran and Gibb (The National Council of Teachers of Mathematics, 1961) described methods for appraising attitudes toward mathematics. Among procedures for measuring attitudes, they distinguished those utilizing self-reports, observer-reports, and interview techniques.

Self-report Attitude Measures

Self-report assessments, which require subjects to complete questionnaires, scales, or other instruments concerning their own attitudes, have been employed most frequently in attitude research. Differing types of attitude scales were developed by Thurstone, Likert, and Guttman.

Thurstone (Thurstone and Chave, 1929) described the construction of equal-appearing interval scales. Such a scale consists of a number of

opinion statements with which a subject is requested to agree or disagree. Each statement is weighed by a panel of experts with respect to its loading of positive or negative attitude. An individual's scale score is the median of the weights of those items with which he is in agreement. Dutton (1956) worked extensively with college and secondary school students using Thurstone-type attitude scales.

The items of a Likert-type attitude scale are opinion statements considered to have equal weight in contributing to the assessment of a subject's attitude (Shaw and Wright, 1967:24). Respondents indicate the degree to which they agree or disagree with each statement. Numerical values are associated with each response level, and the individual's scale score is the sum of these numerical values. Likert-type mathematics attitude scales have been constructed by Adams and Von Brock (1967), Dreger and Aikens (1961), Dutton and Blum (1968), Connelly (1973), and the staff of the School Mathematics Study Group (Crosswhite, 1972).

Guttman-type scales (The National Council of Teachers of Mathematics, 1961:111) are cumulative scales. Statements representing varying levels of positive or negative attitude toward a single construct are presented to the respondent. The response to any one item predicts the responses to other items. A scale of this type for the assessment of mathematics attitudes was constructed by Hoyt and revised by Anttonen (1967).

The semantic differential (Kerlinger, 1973:566-581) has been adapted to the measurement of attitudes in many studies. A semantic differential instrument presents the respondent with bipolar adjective pairs, such as "good-bad" or "pleasant-unpleasant." The respondent indicates his feeling toward a certain concept on a continuum bounded

by the adjectives of a pair. Semantic differential scales were employed to assess mathematics attitudes by Anttonen (1969), Harvill (1971), and Davis and Banning (1968).

In a study of attitude scales of the four types cited above, Mastantuono (1971) found that, for third and fourth grade students, intercorrelations of the four scales were significant at the .01 level. The Hoyt Guttman-type scale correlated most highly with arithmetic grades. Both the Dutton Likert-type scale and the Hoyt scale contributed positively to the prediction of achievement test scores.

Working with the same students a year later, Evans (1972) found test-retest reliability coefficients for the four tests were significant at the .01 level and ranged from .353 to .611. Intercorrelations of the four scales, also significant at the .01 level, ranged from .587 to .827. Evans concluded the four scales measured a common construct.

A two-year study of third through seventh grade students by Malcolm (1971) involved a comparison of the Anttonen revised Hoyt scale and a semantic differential scale. Both scales were found reliable and internally consistent. The Hoyt scale was judged to be superior due to its greater reliability, ease of administration and understanding.

In a study of prospective elementary school teachers, Temple (1972) found that the Dutton Thurstone-type scale, the Aiken-Dreger Likert-type scale, and two semantic differential scales, however, predicted achievement significantly, with the Aiken-Dreger scale the superior predictor.

Attitude scales have been used to assess mathematical attitudes of students from the elementary school level through the college level. Aiken (1970) criticized the suitability of such instruments for elementary

school children, who have limited reading abilities and limited experience. The problem of constructing effective instruments to measure mathematics attitudes of primary students was approached by Fedon (1958), Knaup (1971), Nealeigh (1967), and Harvill (1971).

Working with third graders, Fedon (1958) adapted the Dutton Thurstone-type scale by keying responses to attitude items with affective responses to colors. While Fedon's scale was geared to the color responses of one specific group of children, his work showed that these students had already developed clearcut attitudes toward mathematics.

Knaup (1971) developed pictorial attitude tests to be used with second graders. In two of his tests students chose one of five faces - variously happy or sad - to express their feelings about pictures of mathematics class activities. In two other tests, students chose which of two activity pictures they would prefer to be in.

Nealeigh (1967) prepared a nonverbal test consisting of 310 pairs of pictures. In each pair, one picture contained a mathematical concept. On the basis of student choices of preferred pictures, Nealeigh was able to distinguish between students with positive and negative attitudes toward mathematics. Specific pictures which were significant descriminators, however, varied by pupil grade level.

Harvill (1971) constructed five attitude measures to be used with second and third graders. He employed the semantic differential, forced choice of most liked and least liked of three described activities, choice of preferred activity picture, and two adaptations of Likert-type scales. The intercorrelations for arithmetic attitude score obtained ranged from .54 to .73 and were significant at the .05 level.

In addition to attitude scales, other types of instruments have been used to obtain self-reports of mathematics attitudes. Sawin (1951) assessed mathematics motivation by means of a multiple choice questionnaire. Billig (1944) derived attitude ratings from essays. Herman (1963), Kane (1968), and Keane (1969) asked respondents to rank school subjects in order of most liked and least liked.

Observer-report Attitude Measures

Observer-report measures require a respondent to assess the attitudes of another on the basis of observed behaviors. Such measures have been frequently used in conjunction with self-report measures.

Ellington (1962) asked teachers to rate the mathematics attitudes of junior high school and high school students on a nine-point scale. When these ratings were compared with student attitudes measured by a Thurstone-type scale, a significant correlation ($r = .48$) was found. Teacher ratings were more closely related to teacher awarded grades ($r = .87$), less closely related to achievement test scores ($r = .38$).

Levine (1973) compared the mathematics attitudes of sixth, seventh, and eighth grade students and their mothers by asking each member of a mother child pair to complete Likert-type scales describing their own and each other's attitudes. He observed that the perception of attitudes was more accurate for high achieving students and their mothers. Mothers tended to attribute favorable attitudes to students who were high achievers. Seventh and eighth grade students tended to attribute less favorable attitudes to their mothers than did sixth graders.

Interview Measures of Attitude

Interview measures differ from self-reports and observer-reports in that both respondent and interviewer are directly involved in the attitude assessment. Interviews provide opportunity for the intensive study of a comparatively small number of subjects.

In a study of the relation of parents' and sons' attitudes toward mathematics, Hill (1967) obtained measures of student attitudes from a questionnaire but conducted interviews with parents. Interviews were used by Shapiro (1962) in a study of the mathematics attitudes of intermediate grade elementary students.

STUDENT ATTITUDES TOWARD MATHEMATICS

In addition to assessing the mathematics attitudes of various student groups, researchers have investigated factors contributing to the formation of mathematics attitudes. Among the factors frequently considered were the time when mathematics attitudes were formed and reasons cited by students for liking or disliking mathematics.

Factors in the Formation of Mathematics Attitudes

Several studies conducted with college students have dealt with student reports of the period of their lives in which their mathematics attitudes were formed. Smith (1964) reported that 8.1 percent of 123 preservice elementary school teachers claimed their present attitudes had formed during the intermediate grades four, five, and six; an additional 31.7 percent indicated attitudes formed throughout the elementary school years. Another 15.4 percent reported attitudes crystalized during junior high years, while 13.8 percent indicated attitudes formed

throughout the elementary school years. Another 15.4 percent reported attitudes crystalized during junior high years, while 13.8 percent indicated attitudes formed in senior high school. In a similar study with prospective teachers, Reys and Floyd (1968) found 6.23 percent of 385 subjects claimed attitudes formed during grades one and two, 15.3 percent during grades three and four, 19.2 percent during grades five and six, 41.6 percent during junior high school and 11.4 percent during senior high school.

Young (1932) and Smith (1964) reported reasons given by college students for disliking or liking mathematics. The most frequently cited reasons for losing interest in high school mathematics reported by Young (1932) were difficulty with the material, lack of solid foundation, failure to see a need for the subject, lack of interest in the subject matter, inability to follow the teacher, and teacher incompetence. The primary reasons for disliking mathematics offered to the students of Smith (1964) were lack of understanding, problems with written problems, and long standing lack of success in the subject. The students in Smith's study who liked mathematics most often gave as reasons for this that mathematics was interesting and challenging, necessary in modern life, practical and useful, easy to understand, and provided a feeling of accomplishment.

Poffenberger and Norton (1959) linked the mathematics attitudes of 392 college freshmen with their preceptions of the attitudes of their fathers. Among students who indicated a strong liking for mathematics, 49 percent reported fathers with a strong liking for mathematics. Of those students with a strong dislike for mathematics, 25 percent indicated their fathers had a strong liking for mathematics. The closeness of the

relationship between student and father seemed important. Students with close relationships to their fathers tended to match their fathers in mathematics attitude. Students with distant relationships with their fathers tended to attribute to their fathers less positive mathematics attitudes. In this study, reported mathematics attitudes of mothers were not significantly related to student attitudes. On the basis of interviews, however, Poffenberger and Norton concluded that teacher attitudes had been important in the formation of student attitudes.

About one third of the 459 junior high students in a study by Dutton (1956) reported changes in their mathematics attitudes during one or two years in the junior high school. As reasons for liking arithmetic, Dutton's subjects most frequently cited its practical value, its interest, and its challenge. The most commonly given reasons for disliking arithmetic were failure to understand the subject, the difficulty of the subject, lack of success, and boring repetition in classwork.

Assessments of Student Attitudes Towards Mathematics

Studies of student attitudes toward mathematics have been conducted among students at the elementary school level, at the secondary level, and at the college level. Of special interest were longitudinal studies examining the attitudes of a single group of students over an extended period of time.

Elementary School Students. Stright (1960) examined the mathematics attitudes of 1,023 third, fourth, and sixth grade students using a revised form of the Dutton Thurstone-type scale. She found that 81 percent of the students indicated a real enjoyment of arithmetic, while 20 percent found arithmetic uninteresting. The girls in her sample tended to like

arithmetic more than the boys. A slight decline in the expression of negative attitudes was observed from the third to the sixth graders. In part, Stright attributed this decline to an increase in the desire to conform to expectations among older students.

Fourth, fifth, and sixth graders were studied by Shapiro (1962), who interviewed 30 students--15 boys, 15 girls--at each grade level. No significant changes in mathematics attitudes from grades four through six were observed for the whole group or for boys. The fifth grade girls, however, disliked arithmetic significantly more than the girls of the other grade levels. Fifth grade girls and boys were more influenced by peer attitudes than boys at all levels. Students who liked arithmetic tended to be perseverant in the solution of problems, with girls more perseverant than boys. At all levels, girls who liked arithmetic sought help in problem solving more often than boys. Sixth grade boys who liked arithmetic preferred to work independently.

Herman (1963) studied the subject area preferences of 214 fourth, fifth, and sixth graders. He found that arithmetic generally occupied a middle rank when five subjects were ordered according to preference or when the single most liked subject was named. Faust (1963), however, found that arithmetic was the most preferred of four skill subjects among the 2,535 fifth graders, 54 fourth graders, and 47 sixth graders of her sample.

Fourth graders reported significantly more positive attitudes with respect to personal feelings about arithmetic than did sixth graders in the study of Francies (1971). The sixth graders had somewhat more positive feelings about the important of arithmetic than fourth graders, although the difference was not statistically significant.

Malcolm (1971) concluded that attitudes toward arithmetic become less favorable as students progress through school. Her two-year study treated three groups of students as they advanced from grade three to four, five to six, and six to seven, respectively. Semantic differential attitude scale scores showed a consistent decline across grade level. Hoyt scale scores were highest for fourth graders, lowest for sixth graders. The results for the two attitude scales used, therefore, were inconsistent. Similar inconsistencies were obtained in the analysis of attitude gain scores. Semantic differential gain scores showed negative change at all levels with the greatest change at the seventh grade. While girls' scores were consistently higher than boys', girls' scores showed more negative change than boys'. Hoyt gain scores showed significant negative change at the sixth grade only; other gain score changes were positive.

Beattie (1973) studied the attitudes of a single group of 68 students for three years, beginning with the fourth grade. Using a Likert-type scale adapted from the National Longitudinal Study of Mathematics Abilities Attitude Inventory, Beattie found no trend in attitude change.

Secondary School Students. Among 459 junior high school students surveyed by Dutton (1956), 19 percent indicated a definite dislike for arithmetic. Arithmetic was regarded as important as any other subject by 83 percent. Problems were enjoyed by 87 percent when they knew how to solve them.

Dutton and Blum (1968) found that in a sample of 346 sixth, seventh, and eighth graders, girls liked arithmetic as well as boys. Very favorable attitudes toward new math programs were indicated by 30 percent of the sample; these students scored 21 percent higher on Dutton's

arithmetic attitude scale than students reporting dislike for new math programs.

Jacobs (1974) found no significant differences in the mathematics attitudes of seventh and eleventh grade boys and girls, although seventh graders in general indicated more positive attitudes than eleventh graders. Similarly, high achievers reported more positive attitudes than low achievers.

The mathematics attitudes of 755 junior and senior high school students were assessed by Ellingson (1962). Students in college preparatory classes indicated somewhat more positive attitudes than general mathematics or terminal students.

In his comparison of the mathematics attitudes of 607 fifth and sixth grade students with the attitudes of the same students six years later, Anttonen (1969) found a correlation of .305. Although low, the correlation was significant at the .01 level.

Mosher (1952) examined the subject preferences of 2,164 rural, urban, and mountain students in grades four through twelve. For both boys and girls in grades four through eighth arithmetic was one of the three most preferred subjects. Urban and rural high school boys, but not girls, also listed mathematics among their most preferred subjects.

The National Longitudinal Study of Mathematical Abilities conducted by the School Mathematics Study Group (Crosswhite, 1972) dealt with an extensive stratified random sample of students from grades four through twelve. Results of the study indicated that student mathematics attitudes peak toward the beginning of the junior high school years and decline consistently thereafter.

College Student Attitudes. Roberts (1969) found no significant differences in the mathematics attitudes of terminal mathematics students

beginning either a two-year or four-year college program. Freshman students in an engineering program indicated significantly more positive attitudes toward mathematics than terminal students.

Of 392 freshmen, Poffenberger and Norton (1959) found 25 percent reported a liking for mathematics and 24 percent had an active dislike for the subject. In general, 52 percent liked school very much, while 2 percent disliked school.

Kane(1968) reported that 58 preservice elementary school teachers indicated relatively positive attitudes toward mathematics and the teaching of mathematics. Positive mathematics attitudes were linked with desire to teach in upper elementary grades.

TEACHER ATTITUDES TOWARD MATHEMATICS AND THEIR RELATION TO STUDENT ATTITUDES

Stright (1960) reported that 95 percent of the 29 elementary teachers participating in her survey enjoyed teaching arithmetic. Higdon (1973), in comparing the mathematical skills and attitudes of 724 prospective elementary school teachers and 284 experienced teachers, found no significant difference in total achievement scores between groups, but more positive mathematics attitudes among the experienced teachers.

Evidence provided by interviews with college freshmen in a study by Poffenberger and Norton (1959) seemed to indicate that teacher attitudes had been important in the formation of student attitudes toward mathematics. Faust (1963), studying a large sample of predominantly fifth grade students, found fairly high relationships between teacher and student attitudes toward school subjects.

In general, however, research does not support the hypothesis that the mathematics attitudes of students and their current teachers are strongly

and positively related. Deighan (1971) found no significant relation between teacher and student attitudes toward arithmetic in a study of 1,022 third, fifth, and sixth grade students and their teachers. Keane (1969) studied 16 high attitude elementary school teachers, 16 low attitude teachers, and their students. No conclusive relationship between teacher and student attitude was found. Peskin (1965) found no significant relationship between the mathematics attitudes of teachers and seventh grade mathematics students in nine New York City schools. She reported that intense teacher attitudes seemed to act as a deterrent on student attitudes.

Gordon (1975) examined the mathematics attitudes and attitudes toward classroom structure of 32 teachers and 512 eleventh grade students. Students who agreed with their teachers as to mathematics or classroom structure attitudes were not found to be more comfortable in class.

In contrast, Phillips (1973), comparing the attitudes of 306 seventh grade students with those of their fourth, fifth, and sixth grade teachers, found a relationship significant at the .05 level between student mathematics attitudes and the attitude of the most recent teacher. The type of teacher attitude for two of the three previous years was significantly related to student attitude at the .05 level, also. The relation of type of teacher attitude for three out of three years to student attitude was significant at the .01 level.

PARENT ATTITUDES TOWARD MATHEMATICS AND THEIR RELATION TO STUDENT ATTITUDES

In comparing the attitudes toward subject content curricula of 260 parents and 84 teachers, Hamburg (1972) found parents more positive than teachers toward all subject areas except arithmetic. Mothers and

female teachers were generally more positive toward school subjects than fathers and male teachers. Parents and teachers well acquainted with the total school program were somewhat more positive toward school subjects than less well informed teachers and parents.

Faust (1963) found the attitudes of fifth graders toward school subjects closer to fathers' attitudes than mothers'. Similarly, Poffenberger and Norton (1959) linked the mathematics attitudes of college students with those of their fathers.

Hill (1967) reported that, for the 35 middle class boys of his sample, mothers and sons showed greater mathematics attitude similarity than fathers and sons. The boys tended to conform more to the expectations of fathers than mothers. Fathers with expectations labeled as predominantly masculine and who viewed mathematics as a masculine pursuit had higher levels of aspiration for their sons' performance in mathematics. Generally, the attitudes of parents and their expectations for their sons were not related.

Burbank (1968) compared the mathematics attitudes of 411 seventh grade students with those of their parents. He found significant relationships between the attitudes of mothers and student attitudes and between the attitudes of fathers and student achievement test scores.

THE RELATION OF MATHEMATICS ATTITUDES AND ACHIEVEMENT

A majority of the studies reviewed which dealt with the relation of mathematics attitudes and achievement were concerned primarily with student mathematics attitudes and their relation to achievement. Parent and teacher mathematics attitudes and their relation to student mathematics achievement have been investigated less extensively.

Student Attitudes and Achievement

The relationship of student attitudes toward mathematics and related constructs to student achievement has been investigated in many studies. Among the studies reviewed by the writer, varying results were reported. Five researchers concluded that no relationship existed. Significant relationships were obtained in 25 studies. The differential effects of additional variables on the relationship were discussed by several researchers.

The absence of a relationship between student mathematics attitudes and achievement was reported by Cole (1974), Keane (1969), Connelly (1973), and Dietz (1975). Cole (1974) worked with third graders of average aptitude. Although he concluded there was no significant relationship between attitudes and mathematics achievement, the attitude measure employed in his study measured attitudes toward peers, home, school, and society rather than specific attitudes toward mathematics.

The subjects surveyed by Keane (1969) were elementary school students in the intermediate grades taught by 16 high attitude and 16 low attitude teachers. Keane found no relationship between student mathematics attitudes measured by a Dutton scale and mathematics achievement test scores.

Connelly (1973) employed the Dutton scale and a Likert-type attitude scale based on the taxonomic hierarchy of the affective domain with college students enrolled in an elementary school mathematics education course. He found that mathematics attitudes were not related to overall grade point averages or course grades. In addition, while significant attitude improvement was observed during the course, this improvement was not significantly related to course achievement. Students' mathematics backgrounds were not related significantly to mathematics

attitudes. Dietz (1975), working also with preservice teachers, found attitudes contributed more to retention test scores given two weeks after a unit than to unit post test scores.

A majority of the studies reviewed reported significant relationships between attitude related constructs and achievement. Yates (1975) found a significant positive relationship between self-concept and mathematics achievement for his total sample of 153 third, fourth, and fifth graders and for the girls of the sample. Similarly, Koch (1972) observed a significant relationship between student self-concept and mathematics achievement in 602 rural sixth grade students. Graham (1975) found the mathematics achievement of sixth graders significantly related to behavioral, intellectual, and school status self-concept scales. He found no relationship between mathematics achievement and anxiety or satisfaction self-concept scores.

Deighan (1971) observed a small relationship between arithmetic attitudes and achievement test scores for the third, fifth, and sixth graders of his sample. Lindgren and others (1964) found attitudes favorable toward problem solving correlated significantly and positively with the achievement test scores of fourth year elementary students in Porto Alegre, Brazil, but were not significantly related to class marks.

In the longitudinal study of Beattie, Deichmann, and Lewis (1973), mathematics attitudes and achievement were positively correlated for students in the sample throughout the three years of the study. The correlation decreased each year, however, and attitude was a less useful predictor for achievement than mental ability or prior mathematics achievement. For boys the relation of attitude and achievement increased each year. For girls the relation decreased to zero.

For the fifth grade students of his study, Moore (1972) found both self-concept and mathematics attitudes were significantly but not substantially related to mathematics computation, concepts, and overall achievement. High achievement was found more likely to occur when both self-concept and mathematics attitude scores were high.

Faust (1963) reported a low but significant positive correlation between student arithmetic attitude and achievement scores. The subjects of her study were predominantly fifth graders.

Travers (1971) reported fourth and sixth grade results for the National Longitudinal Study of Mathematics Abilities. Mathematics attitude, self-concept, and anxiety measures were found to relate to under- and overachievement among the students of the sample.

McCormick (1975) reported that, for the intermediate grade students of his sample, self esteem scores provided an effective predictor for arithmetic achievement. He found test anxiety and general anxiety scores negatively related to achievement.

Francies (1971) found significant changes in mathematics attitudes during the course of a school year for the fourth and sixth grade students in her sample. While no difference was observed in the attitudes of medium and low achievers at the start of the year, the attitudes of medium achievers were significantly more positive than those of low achievers at the end of the year.

Neale (1969) concluded that mathematics attitudes were modestly related to mathematics achievement. For the sixth grade boys of his study, 12.5 percent of the variance in post test scores could be attributed to attitudes.

Dwyer (1974) found that sex role standards contributed between one and nine percent of the variance in arithmetic achievement test scores. Bobbe (1971) reported that the fourth and sixth grade students of her sample tended to sex-type school subjects and generally agreed in their judgments. Boys and girls disagreed about arithmetic, however, girls seeing it as feminine, and boys as appropriate for both sexes. A strong relationship between sex-type judgments and subject preferences was noted.

Shepps and Shepps (1971) found school attitudes were not significantly related to mathematics achievement for the boys in a small sample of sixth graders. For the girls in the sample, the correlation between mathematics attitudes and achievement was significant.

Although Basham and others (1964) concluded mathematics attitude was a poor predictor of achievement, they noted a relationship between attitudes and over- and underachievement. In a sample of 159 sixth graders, almost three times as many high attitude students performed significantly above grade level than underachieved. Over four times as many low attitude students performed significantly below grade level than overachieved.

Burek (1975) reported correlations generally ranging from .2 to .4 between mathematics attitudes and achievement of sixth through eighth graders. A cross-lagged panel correlation analysis indicated that achievement predominated over attitude for grades six and seven, but that attitude predominated over achievement in grade eight.

Burbank (1968) found significant correlations between seventh grade students' mathematics attitudes and achievement test scores in mathematical reasoning, concepts, and computation. Overall mathematics achievement was significantly related to attitudes.

Seventh and eighth grade students in accelerated classes had significantly higher mean Dutton attitude scores than students in regular and remedial classes in a study by Stephens (1960). Regular students' attitude scores did not differ significantly from those of remedial students.

Anttonen (1969) reported low but significant correlations between achievement test scores and mathematics attitude scores and between mathematics grade point averages and attitudes for a sample of fifth and sixth grade students. When the same students were retested as eleventh and twelfth graders a higher correlation between mathematics attitudes and grade point averages was observed.

For the seventh graders of her study, Jacobs (1974) found mathematics attitudes accounted for over 24.5 percent of the 25 percent variance in achievement measured. For eleventh graders 27 percent of achievement variance was attributed to attitudes, 6 percent to sex, and 3 percent to the interaction of sex and attitude.

Using the contingency coefficient, Billig (1944) found a significant relationship between the test averages and arithmetic attitudes of tenth grade girls in business arithmetic classes. In a study of the relation of personality type and attitudes to the successful use of programmed instruction in basic mathematics, Davis and Banning (1968) found personality type was overshadowed in predictive ability by attitude. Final grades were found to be heavily influenced by attitudes to teachers and school.

Ellingson (1962) found significant positive correlations among junior and senior high school students between mathematics attitude scores and achievement test scores, mental ability measures, and teacher grades. Attitude scores predicted achievement test scores better than teacher ratings of student attitudes or teacher grades.

Aiken and Dreger (1961) found mathematics attitude scores made a significant contribution to predictions of final course grades for college women in a general mathematics course. Attitude scores were not significantly related to the final grades of male students. Attitude scores did predict gains from pretest to post test, however. In an earlier study with college basic mathematics students, Dreger and Aiken (1957) observed that individuals with high number anxiety tended to make lower course grades.

Temple (1972) found both Dutton and Aiken-Dreger attitude scales were significant predictors of mathematics achievement among prospective elementary school teachers. Semantic differential scales did not predict achievement well.

For the students of an introductory statistics course, Bendig (1954) found mathematics attitude scale scores were significantly related to Kuder Preference Record computational scores, number of courses in high school and college mathematics, and --negatively--to number of psychology courses. Attitude scale scores accounted for 4 to 5 percent of the variance in course grades.

Whipkey (1970) found significant partial correlations between the mathematics attitudes of prospective teachers and several achievement measures when mental ability effects were partialled out. The correlation of attitude and course gain scores was not significant.

Cristantiello (1962) examined relationships between quantitative ability scores and mathematics course grades among college sophomores of varying levels of attitude toward mathematics. Students in each of three curricula--natural science, social science, and business administration--participated in the study. In all groups, significant correlations between

quantitative ability and mathematics attitudes were found for students with middle range attitudes toward mathematics. Similar correlations for high and low attitude students were not significant.

Teacher Attitudes and Student Achievement

The results of Faust (1963), Keane (1969), Koch (1972), Peskin (1965), and Van der Walle (1972) supported the hypothesis of no significant relation between teacher attitudes toward mathematics and student achievement in mathematics.

Phillips (1973) reported significant relationships between the achievement of seventh grade mathematics students and the type of teacher attitude for two and for three of the previous three school years. The interaction of teacher attitudes, student attitudes, and mental ability had no significant effect on student achievement.

Parent Attitudes and Student Achievement

Burbank (1968) found the mathematics attitudes of fathers significantly related to the mathematics achievement scores of seventh grade students. Mothers' attitudes were not significantly related to student achievement. Mehl (1973) found parental attitudes toward school significantly related to the arithmetic achievement scores of elementary school children.

SUMMARY AND CONCLUSIONS

Attitudes toward mathematics have been measured effectively by Likert-, Thurstone-, and Guttman-type scales and the semantic differential. Studies comparing the four instrument types indicated that all

attained acceptable levels of reliability and construct validity. Some studies indicated that Likert-, Thurstone-, and Guttman-type instruments were superior to the semantic differential in predictive validity.

The measurement of mathematics attitude on a single continuum has been employed in the majority of studies. Some more recent studies have been devoted to the identification of various components of mathematics attitude through the use of factor analysis.

Elementary school students tended to rank mathematics toward the middle of preferred school subjects. From 20 to 25 percent of students, however, tended to dislike mathematics actively. Sex differences did not seem significant with respect to mathematics attitudes or achievement among elementary and junior high students. Older studies tended to find mathematics more highly favored by boys than girls at the high school level. More recent studies indicated no significant difference in mathematics attitudes with respect to sex, although boys and girls differed significantly in achievement.

A general decline in student attitudes toward mathematics as students progressed through school was widely reported in the studies reviewed. Some found the decline already present in the intermediate elementary grades. In the National Longitudinal Study of Mathematical Abilities, student mathematics attitudes were found to peak at the seventh grade.

Studies of teacher attitudes found relatively favorable attitudes toward mathematics among elementary school teachers. For the most part, teachers had more favorable attitudes to the teaching of mathematics than to mathematics itself.

In general, the studies reviewed indicated a small but significant relationship between student mathematics attitudes and mathematics achievement. While quantitative aptitudes, mental ability, and prior mathematics achievement seemed more closely related to current mathematics achievement, attitude levels were frequently seen to contribute to over- and underachievement among students.

The mathematics attitude of the current teacher was generally found to be unrelated to student attitudes and achievement. In one study, however, the attitudes of teachers for several prior years were related significantly to student attitudes and achievement.

Parental attitudes were significantly related to student attitudes and achievement in several studies. Some found student attitudes more similar to the attitudes of their mothers; others found the attitudes of fathers more closely related to student attitudes. Student achievement was more consistently found to be related to the attitudes of fathers.

Chapter 3

DESIGN OF THE STUDY

INSTRUMENTS

Instruments for the measurement of mathematics attitudes were constructed by the writer. Two Likert-type attitude scales were prepared--one to be completed by adults participating in the study, a second for the participating seventh grade students. For the measurement of student perceptions of the mathematics attitudes of their parents and most recent mathematics teachers a third instrument was prepared. This instrument, the Feelings About Math scale, also called for students to describe perceptions of their own mathematics attitudes in order to provide a basis for the comparison of attitude scale measures and perception measures.

Items for the mathematics attitude scale for adults were written during the summer of 1974. To insure an acceptable content validity, the Revised Math Attitude Scale of Aiken and Dreger, a twenty item Likert-type scale published by Shaw and Wright (1967:242-243), was employed as a model. The Aiken-Dreger scale was written primarily to be used with college students currently enrolled in mathematics courses. The writer's scale was adapted for the use of respondents no longer in school.

A preliminary form of the writer constructed scale consisted of 16 items. Eight positively expressed items were concerned with the enjoyment of mathematics and past mathematics classes, self-confidence

in working with mathematics, positive and favorable feelings toward mathematics, the appeal of mathematical logic, the enjoyment of computation and problem solving, and the fascination of number relations. Eight negatively expressed items dealt with mental block against mathematics, dread of past mathematics classes, aversion to rigid mathematical structure, discomfort or nervousness when working with mathematics, and feelings of inadequacy or fear of failure when working with mathematics. Respondents could indicate one of five levels of agreement with each item: strongly agree, agree, undecided, disagree, strongly disagree.

The 16 item scale was field tested by the 26 members of a graduate class in elementary school mathematics methods at Louisiana State University. Members of the class were experienced elementary school teachers.

Item analysis showed that twelve items discriminated effectively between respondents with scores in the upper and lower quartiles. For these items, t-ratios were significant at the .01 level of significance. Items which did not discriminate between high and low scoring respondents were those concerned with the fascination of number relations, enjoyment of problem solving, the appeal of computational procedures, and aversion to rigid structure.

The twelve effective items, five positively expressed and seven negatively, were retained as the final form of the mathematics attitude scale for adults (Appendix B). For the field test, the split-half reliability was computed as .94. Since the test was meant to be homogeneous and to measure attitude on one dimension, the Kuder-Richardson procedure was considered to provide a relevant reliability measure (Remmers, Gage, and Rummel, 1965). For ease of calculation, Kuder-Richardson Formula 21

(Thorndike and Hagen, 1969: p. 185) was employed. Reliability computed by Kuder-Richardson Formula 21 was .92.

The mathematics attitude scale for students was a twelve item Likert-type scale. In content, individual items were matched as closely as possible to the items of the adult attitude scale. The vocabulary and reading level of the items were adjusted to make them appropriate for junior high school students. Students were requested to respond to items on one of three levels of agreement: agree, undecided, or disagree.

A preliminary form of the Feelings About Math scale, designed to assess student perceptions of parent and teacher mathematics attitudes, consisted of ten items. Each item was a phrase describing a type of behavior toward mathematics or a feeling about mathematics. Five items were expressed positively and five negatively. Positive items involved the enjoyment of working with numbers, the enjoyment of problem solving, providing help willingly, and answering questions willingly and easily. Negative items concerned dislike of working with numbers and problem solving, avoidance of mathematics work, experiencing difficulty with mathematics, and dislike of helping others with mathematics. Students were instructed to rate themselves, their mothers, fathers, seventh grade mathematics teachers, and previous year's teachers with respect to each item. A + sign was used to indicate that an item was descriptive of an individual's behavior or feelings. A - sign indicated an item inappropriate or incorrect for an individual. A 0 indicated indecision.

The student instruments were tested during the fall of 1975 by two sections of seventh grade students enrolled in the University Laboratory School of Louisiana State University. Complete responses were obtained from 55 students.

Item analysis for the student attitude scale showed that each item discriminated acceptably between students scoring in the upper and lower quartiles. For these items, the computed t-ratios were significant at the .01 level. Kuder-Richardson Formula 21 reliability for the student mathematics attitude scale was .89.

For the section of the Feelings About Math scale dealing with student perceptions of their own feelings, item analysis indicated that nine items discriminated between upper and lower quartile students significantly at the .01 level. The t- ratio for the remaining item was significant at the .05 level. Kuder-Richardson Formula 21 reliability for this section of the questionnaire was .86. Reliabilities for the remaining sections of the test were as follows: perceptions of mother's attitude, .85; father's attitude, .83; seventh grade teacher's attitude, .91; previous year teacher's attitude, .89.

The correlation of student attitude scale scores and Feelings About Math self perception scores was .75. To increase the commonality of the tests, two additional items were added to the Feelings About Math instrument. These items, which matched attitude scale items, dealt with comfort and nervousness when working mathematics.

The mathematics attitude scale for students and the Feelings About Math scale appear in Appendices D and E respectively.

POPULATION OF THE STUDY

Seventh grade students enrolled in the public schools of East Baton Rouge Parish, Louisiana, during the 1975-1976 school year constituted the student population of the study. These students came from a wide range of socio-economic backgrounds, since the parish contains

urban, suburban, and rural areas, is the site of a large petrochemical industry, the home of two state universities, and the seat of the state government.

At the close of the school year, 5,427 students attending 18 schools made up the seventh grade population of East Baton Rouge Parish public schools. About 50.2 percent of these students were girls and 49.8 percent were boys. By race, 37.7 percent of the students were black and 62.3 percent were white.

THE STUDENT MAILING SAMPLE

A random sample of 364 seventh grade students was drawn for the writer by the staff of the East Baton Rouge Parish School Board. Since all enrollment and attendance records for the parish were computerized, the mailing sample was drawn by computer techniques and provided the names of students and parents, race and sex of students, their schools, mailing addresses, and telephone numbers.

Students from all 18 parish schools with seventh grade classes were included in the mailing sample. Of the 364 students of the sample, 48.4 percent were girls; 51.6 percent were boys. Black students made up 38.1 percent of the mailing sample; white students, 61.2 percent. Chi-square analysis indicated the mailing sample did not differ significantly from the study population in its composition by race and sex.

THE DISTRIBUTION OF INSTRUMENTS TO STUDENTS AND PARENTS

During the spring of 1976, packets were mailed to the parents of the students in the mailing sample. Each packet contained the following items:

a stamped envelope for the return of completed instruments;

a cover letter from the writer describing the nature and purpose of the study;

a letter of endorsement signed by members of the school board staff indicating their approval of the study;

copies of the adult mathematics attitude scale for each of the student's parents;

copies of the mathematics attitude scale for students and the Feelings About Math scale to be completed by the student;

a release form to be signed by parents granting the writer permission to examine school records in order to determine the student's mathematics grades for the first three grade periods of the year and to identify the seventh grade mathematics teacher and previous year teacher.

After three weeks telephone calls were made to the parents who had not returned packets. The purpose of the calls was to provide parents with additional information concerning the study and to invite their support. Members of the Cooperative Office Education class of a city high school under the instruction of their teacher and the writer made the telephone canvass.

After an additional three week period, a second mailing of packets was made to parents who had not responded.

THE STUDY SAMPLE

Completed packets were returned by the parents of 145 students. These students, who made up the study sample, constituted 39.8 percent of the mailing sample. The students attended 17 of the 18 public schools of the parish with seventh grade classes. Of the students, 51.7 percent

were girls and 48.3 percent were boys. By race, 34.8 percent were black and 66.2 percent were white. Chi-square analysis indicated that the study sample did not differ significantly from the mailing sample with respect to sex, race, or distribution in parish schools.

Mathematics attitude scales were completed by 144 students, 140 mothers, and 98 fathers. An important factor in the loss of data for parents was the comparatively high incidence of single parent families in the mailing sample.

THE IDENTIFICATION OF STUDENT GRADES AND TEACHERS

When the students participating in the study had been identified, school records were consulted to determine their mathematics grades and to identify their mathematics teachers. Mathematics marks for the first three nine week grade periods of the school year and sixth grade teachers were identified from the students' permanent records maintained in the school of attendance. Current schedule cards identified seventh grade teachers.

DISTRIBUTION OF INSTRUMENTS TO TEACHERS

Toward the end of the school year, adult mathematics attitude scales were delivered to all seventh grade mathematics teachers and all sixth grade teachers of the parish system at their schools. After the close of school, additional copies of the scale were mailed to teachers who had not returned completed scales and had taught students participating in the study. A telephone canvass of these teachers was also made at this time.

Of the 51 seventh grade teachers who had taught students in the study sample, 46 (90.2 percent) completed attitude scales. Of 103 sixth grade teachers, 84 (81.6 percent) completed scales.

TREATMENT OF THE DATA

Attitude scale scores for students, mothers, fathers, seventh grade mathematics teachers, and sixth grade teachers were computed and the distribution of the data for each group was analyzed. For each group, Kuder-Richardson Formula 21 reliabilities were computed.

For the adult respondent groups attitude scale score means were compared by t-tests to determine whether significant differences in mathematics attitude existed among these groups. Mathematics grade point averages and mathematics attitude scale scores for boys and girls in the student sample were similarly compared by t-tests to determine significant differences with respect to these variables.

Data from the Feelings About Math scale were similarly analyzed. Kuder-Richardson Formula 21 reliabilities were computed for the responses on each section of this scale. The perceptions by boys and girls of the attitudes of parents and teachers were analyzed to determine significant differences.

The purpose of the study was to seek answers to three groups of questions. The calculation of correlation coefficients, coefficients of contingency, and multiple regression analysis were the statistical tools used to provide these answers.

Questions of the first group dealt with the relation of student perceptions of mathematics attitudes to scale measured attitudes for the students, their mothers, fathers, seventh grade mathematics teachers, and

sixth grade teachers. Answers to the questions of this group were obtained by computing the correlation coefficients of student perception scores and attitude scale scores for each pertinent subgroup. Correlations were computed overall and by student sex.

The second group of questions was concerned with the relation of parent and teacher attitudes and student perceptions of these attitudes to the attitudes of students. Three multiple regressions were computed to provide answers for these questions.

The first regression dealt with the relation to student mathematics attitudes of parent and teacher attitudes. For this regression the dependent variable was scale measured student mathematics attitude and independent variables were student sex, the scale measured mathematics attitudes of mothers, fathers, seventh grade teachers, and sixth grade teachers, and the second order interactions of these attitudes.

In order to utilize more fully the available data, a second multiple regression employing attitude scale measures was performed. For this second regression, the dependent variable was student mathematics attitude scale score and independent variables were student sex, scale measured mathematics attitudes of mothers and seventh grade teachers and the interaction of these attitudes.

The third regression analysis related student mathematics attitudes and student perceptions of parent and teacher attitudes. The dependent variable for this regression was scale measured student mathematics attitude and independent variables were student sex, student perceptions of the mathematics attitudes of mothers, fathers, seventh grade

mathematics teachers, and sixth grade teachers, and the second order interactions of these perceptions.

The relation of student mathematics attitudes to the number of adults perceived as having highly positive mathematics attitude was examined. Contingency tables were constructed and coefficients of contingency were calculated.

Questions of the third group dealt with the relation of student, parent, and teacher attitudes and student perceptions of these attitudes to the mathematics grade point averages of students. Two multiple regressions were performed to provide answers to these questions. The dependent variable for each regression analysis was student mathematics grade point average. For the first regression, the independent variables were student sex and scale measured mathematics attitudes of students, their mothers, fathers, seventh grade mathematics teachers, sixth grade teachers, and the second order interactions of these attitudes. For the second regression, student perceptions of attitudes replaced scale measured attitudes as independent variables.

Chapter 4

PRESENTATION AND ANALYSIS OF DATA

CHARACTERISTICS OF THE DATA

For each respondent group, the distribution of data for each variable studied was analyzed. Reliabilities were computed by Kuder-Richardson Formula 21. Where appropriate, comparisons were made to determine the significance of differences in the responses of the groups.

Student Sample

For the seventh grade students of the study sample, mathematics course grades, mathematics attitude scale scores, and responses to the Feelings About Math scale were analyzed. Response differences due to student sex were evaluated by t-tests.

Mathematics Grades. Seventh grade mathematics marks for the first three nine week periods of 1975-1976 were available for 144 student respondents. The distribution of these grades is shown in Table 1.

The mathematics grade point average for boys was 7.03; for girls, 7.66; for the whole sample, 7.35. Interpreted as letter grades, these means fell between the B and C levels. Close to half of the sample students had A or B mathematics averages. Less than a fourth of the students had D or F averages.

While the girls of the sample had higher grades than the boys, computation of the t-ratio indicated that the difference of the means

for boys and girls was not statistically significant (Table 2). Thus, the mathematics grades of students in the sample did not differ significantly by sex.

Table 1

Distribution of Grade Points in Seventh Grade Mathematics Accumulated by Student Respondents during the First Three Grade Periods of 1975-1976, by Sex

Accumulated Grade Points	Letter Grade Equivalent	Boys	Girls	Total
11 - 12	A	17	17	34
8 - 10	B	14	22	36
5 - 7	C	19	22	41
2 - 4	D	16	11	27
0 - 1	F	4	2	6
Total		70	74	144

Table 2

Comparison of Student Grade Point Means by Sex

Student Sex	Number of Respondents	Grade Point Mean	Grade Point Standard Deviation	Difference of Means	t
Male	70	7.03	3.52	.63	1.13
Female	74	7.66	3.16		

Mathematics Attitude Scale Scores. The mathematics attitude scale for students was also completed by 144 students in the sample. The distribution of these scores is shown in Table 3.

Half the student respondents reported highly positive attitudes toward mathematics. Highly negative mathematics attitudes were reported

by 11.1 percent of the students. The mean mathematics attitude scale score for boys was 16.93; for girls, 16.83; for the whole sample, 16.88. Since a scale score of 12 indicated a neutral attitude toward mathematics and a score of 24 indicated the highest degree of positive attitude measured, the mean scores represented fairly positive attitudes toward mathematics. Computation of the t-ratio indicated that the boys and girls of the sample did not differ significantly with respect to mathematics attitude (Table 4).

Table 3

Distribution of Mathematics Attitude Scale Scores of Student Respondents, by Sex

Attitude Scale Scores	Boys	Girls	Total
19 - 24	37	37	74
13 - 18	16	17	33
7 - 12	8	13	21
0 - 6	9	7	16
Total	70	74	144

Table 4

Comparison of Student Mathematics Attitude Scale Score Means, by Sex

Student Sex	Number of Respondents	Mathematics Scale Score Mean	Mathematics Scale Score Standard Deviation	Difference of Means	t
Male	70	16.93	5.75	.10	.09
Female	74	16.83	6.85		

Feelings About Math Scores. The Feelings About Math scale was completed, as a whole or in part, by 143 students. Self ratings were provided by 143 students. Mother's mathematics attitude ratings were completed by 131 students, father's attitude ratings by 120, seventh grade mathematics teacher's attitude ratings by 127, and sixth grade teacher's attitude ratings by 123. The distribution of Feelings About Math ratings is shown in Table 5. Mean student self rating scores fell between the neutral score 12 and the maximum positive score 24. For boys, the mean self rating was 16.90; for girls, 16.19; for the whole sample, 16.54. Student self ratings did not differ significantly by sex (Table 6).

Comparisons of student ratings of adult attitudes toward mathematics also indicated that these ratings did not differ significantly by student sex. Computed values of t were uniformly small (Table 7).

Mean adult attitude ratings for the whole student sample were as follows: Seventh grade mathematics teacher, 20.26; Sixth grade teacher, 19.14; Father, 18.61; Mother, 15.60. Since these means fell between the neutral 12 and the maximum 24, students in general attributed fairly positive mathematics to their parents and teachers.

Pairwise comparisons of adult group means by t tests (Table 8) yielded these results. Students rated the mathematics attitudes of seventh grade mathematics teachers significantly higher than those of their fathers and mothers. The attitudes of fathers and sixth grade teachers were rated significantly higher than those of mothers. These rating differences were significant at the .01 level of confidence. The mathematics attitudes of seventh grade teachers were rated somewhat higher than those of sixth grade teachers; the difference was close to

Table 5

Distribution of Student Ratings of Mathematics Attitudes
by Sex and Respondent Group

Rating Scores	Self Rating			Mother's Rating			Father's Rating			Seventh Grade Mathematics Teacher's Rating			Sixth Grade Teacher's Rating		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
19 - 24	36	36	72	27	27	54	30	37	67	46	44	90	40	41	81
13 - 18	17	18	35	18	18	36	19	14	33	10	18	28	14	15	29
7 - 12	11	9	20	11	15	26	7	10	17	6	3	9	6	4	10
0 - 6	6	10	16	8	7	15	1	2	3	0	0	0	1	2	3
Totals	70	73	143	64	67	131	57	63	120	62	65	127	61	62	123

significance at the .05 level. There was no significant difference between the student ratings of the mathematics attitudes of fathers and sixth grade teachers.

Table 6

Comparison of Student Mathematics Attitude Self Rating Means, by Sex

Student Sex	Number of Respondents	Self Rating Mean	Self Rating Standard Deviation	Difference of Means	t
Male	70	16.90	6.33	.71	.63
Female	73	16.19	7.11		

Table 7

Comparison of Means of Student Ratings of Mathematics Attitudes of Parents and Teachers, by Sex

Adult Rated	Student Sex	Number of Ratings	Rating Mean	Rating Standard Deviation	Difference of Means	t
Mother	Male	64	15.73	6.94	.26	.23
	Female	67	15.46	6.63		
Father	Male	57	18.39	5.19	.42	.43
	Female	63	18.81	5.61		
Seventh Grade Mathematics Teacher	Male	62	20.24	3.91	.04	.05
	Female	65	20.28	4.26		
Sixth Grade Teacher	Male	61	19.07	5.11	.14	.16
	Female	62	19.21	4.98		

Reliabilities of Attitude Scale Scores and Ratings. The internal consistency reliabilities of student mathematics scale scores and Feelings About Math ratings were computed under Kuder-Richardson Formula 21. These reliabilities, which varied from .88 to .93, are shown in Table 9.

Table 8

Pairwise Comparisons of Means of Overall Student Ratings of Mathematics Attitudes of Parents and Teachers

Adult Rated	Number of Ratings	Rating Mean	Rating Standard Deviation	Difference of Means	t
Seventh Grade Mathematics Teacher	127	20.26	4.07	4.66	6.69**
Mother	131	15.60	6.76		
Seventh Grade Mathematics Teacher	127	20.26	4.07	1.65	2.72**
Father	120	18.61	5.40		
Seventh Grade Mathematics Teacher	127	20.26	4.07		
Sixth Grade Teacher	123	19.14	5.02	1.12	1.94*
Sixth Grade Teacher	123	19.14	5.02	3.54	4.72**
Mother	131	15.60	6.76		
Sixth Grade Teacher	123	19.14	5.02	.53	.79
Father	120	18.61	5.40		
Father	120	18.61	5.40	3.01	3.88**
Mother	131	15.60	6.76		

*Significant at the .05 level.

**Significant at the .01 level.

Table 9

Reliabilities of Student Responses Computed by Kuder-Richardson Formula 21

Instrument	Reliability Coefficient
Student Mathematics Attitude Scale	.91
Feelings about Math Self Rating	.93
Feelings about Math Mother's Rating	.92
Feelings about Math Father's Rating	.89
Feelings about Math Seventh Grade Mathematics Teacher's Rating	.84
Feelings about Math Sixth Grade Teacher's Rating	.88

Adult Respondent Groups

Mathematics attitude scale scores for parents and teachers were analyzed and compared. In addition, the overall ranking of student perceptions of parent and teacher attitudes was compared to the ranking of the means of adult attitude scores.

Adult Mathematics Attitude Scale Scores. The mathematics attitude scale for adults was completed by 140 mothers of students in the sample, 98 fathers, 46 seventh grade teachers, and 84 sixth grade teachers. The distribution of these scores is shown in Table 10.

Mean mathematics attitude scale scores for each adult group fell between a neutral score of 24 and the maximum positive score 48. For seventh grade teachers, the mean attitude scale score was 42.67; for sixth grade teachers, 36.61; for fathers, 34.18; for mothers, 30.13.

Table 10

Distribution of Mathematics Attitude Scale Scores for Adult Respondent Groups

Attitude Scale Scores	Mothers	Fathers	Seventh Grade Mathematics Teachers	Sixth Grade Teachers
37 - 48	38	41	42	50
25 - 36	62	44	3	25
13 - 24	31	10	1	8
0 - 12	9	3	0	1
Totals	140	98	46	84

Pairwise comparison of these means by t-test were made (Table 11). At the .01 level of confidence, scale scores of seventh grade teachers were significantly higher than those of sixth grade teachers, fathers, and mothers. Also at the .01 level, the scores of sixth grade teachers and those of fathers were significantly higher than the scores of mothers. There was no significant difference between the scores of fathers and sixth grade teachers.

Reliability of Adult Scale Scores. Kuder-Richardson Formula 21 reliability coefficients for adult attitude scale scores ranged from .89 to .91. These reliabilities are shown in Table 12.

Comparison of the Ranking of Adult Group Scale Scores and Student Ratings of Adults. The ranking of attitude scale score means for adult respondent groups was identical to the ranking of the means of student attitude ratings for these groups (Table 13). In each case, seventh grade teachers had the highest mean score, with sixth grade

Table 11

Pairwise Comparisons of Mathematics Attitude Scale Score Means for Adult Respondent Groups

Adult	Number of Respondents	Mean Attitude Scale Score	Attitude Scale Score Standard Deviation	Difference of Means	t
Seventh Grade Mathematics Teacher	46	42.67	6.10	12.54	10.01**
Mother	140	30.13	9.79		
Seventh Grade Mathematics Teacher	46	42.67	6.10	8.49	6.47**
Father	98	34.18	9.44		
Seventh Grade Mathematics Teacher	46	42.67	6.10	6.07	4.77**
Sixth Grade Teacher	84	36.61	8.25		
Sixth Grade Teacher	84	36.61	8.25	6.48	5.17**
Mother	140	30.13	9.79		
Sixth Grade Teacher	84	36.61	8.25	2.42	1.85
Father	98	34.18	9.44		
Father	98	34.18	9.44	4.06	3.21**
Mother	140	30.13	9.79		

**Significant at the .01 level.

teachers, fathers, and mothers following in order. The statistical significance of the differences of the means was also identical except in the comparison of attitudes of sixth and seventh grade teachers. While students ranked the attitudes of seventh grade teachers above those of sixth grade teachers, the difference did not reach significance at the .01 level as did the difference of the scale scores for the teacher groups. An examination of the student ratings showed that means for mothers, fathers, and sixth grade teachers were comparatively higher than the corresponding attitude scale means, while the student rating for seventh grade teachers was lower than the corresponding scale mean.

Table 12

Reliabilities of Adult Attitude Scale Responses
Computed by Kuder-Richardson Formula 21

Respondent Group	Reliability Coefficient
Mothers	.90
Fathers	.91
Seventh Grade Mathematics Teachers	.89
Sixth Grade Teachers	.89

RELATIONSHIPS AMONG MATHEMATICS ATTITUDES, PERCEPTIONS OF MATHEMATICS ATTITUDES, AND STUDENT SUCCESS IN MATHEMATICS

The study of relationships among mathematics attitudes, perceptions of mathematics attitudes, and student success in mathematics was concerned specifically with the relations between the following variables:

student mathematics attitude scale scores and student self ratings on the Feelings About Math scale;

Table 13

Ranking of Adult Attitude Scale Score Means and Mean Student Ratings of Adult Attitudes

Adult Respondent Group	Attitude Scale Means		Student Ratings Means	
	Raw Score	Converted Score (Maximum 4)	Raw Score	Converted Score (Maximum 4)
Seventh Grade Mathematics Teachers	42.67	3.56	20.26	3.38
Sixth Grade Teachers	36.16	3.01	19.14	3.19
Fathers	34.18	2.84	18.61	3.10
Mothers	30.13	2.51	15.60	2.60

seventh grade teacher mathematics attitudes and student ratings of these attitudes;

sixth grade teacher mathematics attitudes and student ratings of these attitudes;

the mathematics attitudes of mothers and student ratings of these attitudes;

the mathematics attitudes of fathers and student ratings of these attitudes;

adult mathematics attitudes and student attitude scale scores;

student perceptions of adult attitudes and student attitude scale scores;

student perceptions of adult attitude and student self ratings on the Feelings About Math scale;

mathematics attitudes and student grades in mathematics;

student perceptions of mathematics attitude and student grades in mathematics.

Student Attitude Scale Scores and Student Feelings About Math Self Ratings

The overall coefficient of correlation between student mathematics attitude scale scores and student self ratings from the Feelings About Math scale was .815. For boys in the sample the correlation was .773; for girls, .856. The correlations were significant at the .01 level.

The correlations for boys and girls were transformed into Fisher coefficients and the critical ratio was computed. The value of the critical ratio indicated that the difference in correlations was not statistically significant (Table 14).

For the students of the study, therefore, there was a strong, positive relationship between mathematics attitude scale scores and Feelings About Math self perceptions. Within the context of the study, the two instruments seemed to measure much the same construct.

Table 14

Correlation of Mathematics Attitude Scale Scores of Students and Student Self Ratings on Feelings About Math Scale

Student Sex	Number of Respondents	Correlation Coefficient	Critical Ratio
Male	70	.773**	1.42
Female	72	.856**	
Total	142	.815**	

**Significant at .01 level.

Attitude Scale Scores and Student Ratings of Attitudes for Seventh Grade Teachers

The overall coefficient of correlation between mathematics attitude scale scores and student ratings of mathematics attitudes for seventh grade mathematics was -.103. For boys the correlation was -.102; for girls, -.099. The correlations were not statistically significant (Table 15).

Table 15

Correlation of Seventh Grade Mathematics Teachers' Mathematics Attitude Scale Scores and Student Ratings of These Attitudes

Student Sex	Number of Respondents	Correlation Coefficient
Male	57	-.102
Female	60	-.099
Total	117	-.103

Attitude Scale Scores and Student Ratings of Attitudes for Sixth Grade Teachers

For the whole sample, a correlation coefficient of -.047 was obtained between the mathematics attitude scale scores of sixth grade teachers and student ratings of these attitudes. For boys, the correlation was -.026; for girls, -.079. The correlations were not statistically significant (Table 16).

Table 16

Correlation of Sixth Grade Teachers' Mathematics Attitude Scale Scores and Student Ratings of These Attitudes

Student Sex	Number of Respondents	Correlation Coefficient
Male	47	-.026
Female	48	-.079
Total	95	-.047

Attitude Scale Scores and Student Ratings of Attitude for Mothers

A correlation coefficient of .570 was obtained between the mathematics attitude scale scores of mothers and student perception ratings of these attitudes for the whole sample. The correlation for boys in the sample was .648; for girls the correlation was .495. The correlations were significant at the .01 level. Transformation to Fisher z coefficients and computation of the critical ratio indicated that the difference in correlations by sex was not statistically significant (Table 17).

Table 17

Correlation of Mothers' Mathematics Attitude Scale Scores and Student Ratings of These Attitudes

Student Sex	Number of Respondents	Correlation Coefficient	Critical Ratio
Male	62	.648**	1.270
Female	65	.495**	
Total	127	.570**	

**Significant at the .01 level.

Attitude Scale Scores and Student Ratings of Attitude for Fathers

For the whole sample, the coefficient of correlation between the mathematics scale scores of fathers and student ratings of these attitudes was .615. For boys, the correlation was .473; for girls, the correlation was .769. The correlations were significant at the .01 level. Transformation to Fisher z coefficients and computation of the critical ratio indicated that the correlations differed by sex significantly at the .05 level in favor of the girls (Table 18).

Table 18

Correlation of Fathers' Mathematics Attitude Scale Scores and Student Ratings of These Attitudes

Student Sex	Number of Respondents	Correlation Coefficient	Critical Ratio
Male	49	.473**	2.44*
Female	47	.769**	
Total	96	.615**	

*Significant at the .05 level.

**Significant at the .01 level.

Adult Attitude Scale Scores and Student Attitude Scale Scores

The relationship between adult mathematics attitudes and student attitude scale scores was analyzed by the computation of simple coefficients of correlation and through multiple regression analysis.

Coefficients of Correlation. Using all available data, coefficients of correlation were computed between student mathematics attitude

scale scores and the attitude scale scores of each adult respondent group. These correlations are summarized in Table 19.

One correlation was significant at the .01 level, that between mother's scale score and student scale score for the whole sample. For girls, the correlation between student attitude scale score and mother's attitude scale score approached significance ($p < .10$) and was positive. The correlation between attitude scale score for girls and seventh grade teachers approached significance ($p < .10$) and was negative.

Regression Analysis. To examine the relation of student attitude scale scores and the scale scores of the adult respondent groups together with the interactions of these scores, multiple regression analysis was performed. The dependent variable of the regression was student mathematics attitude scale score. Independent variables were student sex, attitude scale scores for mothers, fathers, seventh grade mathematics teachers, sixth grade teachers, and the second order interactions of these scores.

Because of incomplete data returns and the high incidence of single parent families in the study sample, the data available for the regression analysis were severely restricted. Complete attitude scale data were available for 70 of the 145 students in the sample. A comparison of these 70 students with the whole sample indicated that data loss was somewhat heavier for girls than boys and was particularly heavy among students with mathematics grade averages of C or lower (Table 20).

The results of the regression analysis are shown in Table 21. The obtained value of R^2 was not statistically significant. None of the

Table 19

Correlations Between Student Attitude Scale Scores and Attitude Scale Scores of Adult Respondent Groups

Student Sex	Number of Respondents	Correlation
	Mothers	
Male	67	.149
Female	73	.194≠
Total	140	.174*
	Fathers	
Male	51	.090
Female	47	-.006
Total	98	.045
	Seventh Grade Mathematics Teachers	
Male	65	-.039
Female	69	-.202≠
Total	134	-.130
	Sixth Grade Teachers	
Male	55	-.084
Female	55	-.095
Total	110	-.005

≠Approaching significance ($p < .10$).

*Significant at .05 level.

Table 20

Comparison of Students for Whom Complete Attitude Data Were Available with Total Student Sample

Accumulated Grade Points	Number With Complete Attitude Data	Number in Total Sample	Percent of Number in Total Sample With Complete Attitude Data
		Girls	
11-12	11	17	64.7
8-10	12	22	54.5
5-7	8	22	36.4
2-4	1	11	0.9
0-1	0	2	0.0
Total	32	74	43.2
		Boys	
11-12	13	17	76.5
8-10	10	14	71.4
5-7	7	19	36.8
2-4	7	16	43.7
0-1	1	4	25.0
Total	38	70	54.3
		Total	
11-12	24	34	70.6
8-10	22	36	61.6
5-7	15	41	34.1
2-4	8	27	29.6
0-1	1	6	16.7
Total	70	144	48.6

independent variables made a contribution to the prediction of student attitude scale score which was significant at the .05 level. The most significant contributions to predictions of student mathematics attitude score were made by the interaction of seventh grade and sixth grade teacher scale scores ($p < .10$) and the seventh grade teacher scale score, close to significance at the .10 level.

In the regression equation, coefficients for eight independent variables were positive, indicating that increased values for these variables resulted in greater predicted values for student mathematics attitude. The variables, in the order of coefficient magnitude, were father's attitude (0.19), interaction of attitudes of mother and seventh grade teacher (0.04), interaction of attitudes of sixth and seventh grade teachers (0.04, significant at .10 level), interaction of attitudes of father and seventh grade teacher (0.02), square of seventh grade teacher's attitude (0.01), interaction of attitudes of mother and seventh grade teacher (0.01), square of mother's attitude (0.003), and square of sixth grade teacher's attitude (0.0003).

For six variables, regression equation coefficients were negative, indicating that increases in these measures resulted in decreases in predicted values of student mathematics attitude. These variables, in order of coefficient magnitude, were seventh grade teacher's attitude (-4.95), mother's attitude (-1.96), sixth grade teacher's attitude (-1.60), the interactions of attitudes of father and sixth grade teacher (-0.02), mother and father (-0.01), and the square of father's attitude (-0.01).

In order to utilize the available data more fully, a second regression analysis was performed. For the second regression, the

Table 21

Multiple Regression of Student Mathematics Attitude on Student Sex, Parent and Teacher Mathematics Attitudes and the Second Order Interactions of These Attitudes

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F	R^2
Regression	15	841.63	56.11	1.19	.249
Error	54	2541.36	47.06		
Corrected Total	69	3382.99			

Source of Variance	Degrees of Freedom	Partial Sum of Squares	F	Regression Coefficient	t
Student Sex	1	11.25	0.19	--	--
Mother's Attitude	1	73.84	1.96	-1.96	-1.25
Father's Attitude	1	1.10	0.29	0.19	0.15
Seventh Grade Mathematics Teacher's Attitude	1	127.30	3.56	-4.95	-1.64
Sixth Grade Teacher's Attitude	1	55.26	0.76	-1.60	-1.08
Interactions of Attitude					
(Mother's Attitude) Mother x Mother	1	4.67	0.19	0.003	0.31
(Father's Attitude) Father x Father	1	31.65	0.67	-0.007	-0.82
(Seventh Grade Mathematics Teacher's Attitude) Seventh Grade Teacher x Seventh Grade Teacher	1	8.48	0.04	0.014	0.42
(Sixth Grade Teacher's Attitude) Sixth Grade Teacher x Sixth Grade Teacher	1	0.04	0.15	0.0003	0.03
Mother x Father	1	19.34	0.32	-0.006	-0.64
Mother x Seventh Grade Teacher	1	86.33	3.62	0.04	1.35
Mother x Sixth Grade Teacher	1	42.92	0.54	0.01	0.95
Father x Seventh Grade Teacher	1	78.97	1.61	0.02	1.30
Father x Sixth Grade Teacher	1	69.40	1.02	-0.02	-1.21
Seventh Grade Teacher x Sixth Grade Teacher	1	140.21	2.98≠	0.04	1.72≠
Regression Intercept				180.02	2.08*

*Significant at the .05 level.

≠Approaching significance ($p < .10$).

dependent variable was student attitude scale score and independent variables were student sex, the attitude scale scores of mothers and seventh grade teachers, and the interaction of these attitudes. Data for 130 students were used in the second regression analysis.

The results of the regression are shown in Table 22. The obtained value of R^2 was .0625 and approached significance ($p < .10$). Of the independent variables, seventh grade teacher's attitude was significant at the .05 level. Mother's attitude and the interaction of mother's and seventh grade teacher's attitudes approached significance ($p < .10$). Regression equation coefficients for mother's and seventh grade teacher attitudes were negative. For the interaction, the coefficient was positive but small.

Table 22

Multiple Regression of Student Mathematics Attitude on Student Sex, Mathematics Attitudes of Mothers and Seventh Grade Mathematics Teachers and the Interaction of These Attitudes

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F	R^2
Regression	4	353.81	88.45	2.08≠	.062
Error	125	5307.49	42.46		
Corrected Total	129	5661.30			

Source of Variance	Degrees of Freedom	Partial Sum of Squares	F	Regression Coefficient	t	Regression Intercept
Student Sex	1	0.50	0.01	--	--	
Mother's Attitude	1	130.33	2.99≠	-1.15	-1.75≠	57.00
Seventh Grade Mathematics Teacher's Attitude	1	201.91	1.66*	-0.95	-2.18*	
Interaction	1	155.57	3.67≠	0.03	1.91≠	
Regression Intercept				57.00	2.87**	

**Significant at .01 level.
*Significant at .05 level.
≠Approaching significance ($p < .10$).

Student Ratings of Adult Mathematics Attitudes and Student Attitude Scale Scores

The computation of coefficients of correlation and multiple regression analysis were used to analyze the relationship between student perceptions of adult mathematics attitudes and student attitude scale scores.

Coefficients of Correlation. Coefficients of correlation were computed between student mathematics attitude scale scores and student ratings of the mathematics attitudes of each adult respondent group. The correlations are presented in Table 23. The coefficient of correlation between student attitude scale score and student ratings of the mathematics attitudes of seventh grade teachers was significant at the .05 level. Two correlations, that between boys' attitudes scale scores and their ratings of father's attitude toward mathematics and that between girls' attitude scale scores and their ratings of mother's attitudes approached significance ($p < .10$). No other correlations were significant.

Regression Analysis. A multiple regression analysis was performed employing student mathematics attitude scale scores as the dependent variable and as independent variables student sex, student ratings of the mathematics attitudes of mothers, fathers, seventh grade teachers, sixth grade teachers, and the second degree interactions of these perception ratings. Complete data for 109 students of the sample were available for this regression.

The results of the regression analysis are summarized in Table 24. The value of R^2 obtained was not statistically significant. None of the

Table 23

Correlations Between Student Mathematics Attitude Scale Scores and Student Ratings of the Mathematics Attitude of Parents and Teachers

Student Sex	Number of Respondents	Correlation
Mothers		
Male	64	.093
Female	66	.223≠
Total	130	.160
Fathers		
Male	57	.217≠
Female	62	.098
Total	119	.151
Seventh Grade Mathematics Teachers		
Male	62	.159
Female	64	.198
Total	126	.179*
Sixth Grade Teachers		
Male	61	.003
Female	61	.009
Total	122	.006

≠Approaching significance ($p < .10$).

*Significant at .05 level.

independent variables made statistically significant contributions to the prediction of student attitude scale scores.

Variables with positive regression equation coefficients were the attitude ratings for sixth grade teacher (1.21), father (0.72), and mother (0.70), and the interactions of attitude ratings for father and seventh grade teacher (0.03), father and sixth grade teacher (0.01), and the square of mother's attitude rating (0.01). Variables with negative coefficients in the regression equation were the seventh grade teacher's rating (-1.49), the squares of ratings for father (-0.04), and seventh grade teacher (-0.04), the square of sixth grade teacher rating (-0.03), and the interactions of ratings for mother and seventh grade teacher (-0.01), mother and father (-0.004), and sixth and seventh grade teachers (-0.003).

Comparison of the Regressions of Student Attitudes on Attitude Scores and Attitude Ratings. For the regression of student mathematics attitude scores on the mathematics attitude scale scores of parents and teachers R^2 was .249. For the regression of student mathematics attitudes on student ratings of parent and teacher attitudes R^2 was .178. Neither multiple correlation was statistically significant.

For each of the regression equations, however, three related variables had positive coefficients. These variables were measures of father's mathematics attitude, the interaction of measures of father's and seventh grade teachers' attitudes, and the square of the measure of mother's attitude.

Another three variables had negative coefficients in both regression equations. These variables were the measure of seventh grade

Table 24

Multiple Regression of Student Mathematics Attitude on Student Sex, Student Ratings of the Mathematics Attitudes of Parents and Teachers, and the Second Order Interactions of These Ratings

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F	R^2
Regression	15	851.08	56.74	1.34	.178
Error	93	3937.36	42.34		
Corrected Total	108	4788.44			

Source of Variance	Degrees of Freedom	Partial Sum of Squares	F	Regression Coefficient	t
Student Sex	1	0.32	0.03	--	--
Mother's Rating	1	25.35	3.55	0.70	.77
Father's Rating	1	22.36	1.68	0.72	.73
Seventh Grade Teacher	1	25.78	0.35	-1.49	-.78
Sixth Grade Teacher	1	63.32	2.06	1.21	1.22
Mother x Mother	1	14.75	0.30	0.01	.59
Father x Father	1	99.67	4.01	-0.04	-1.53
Seventh Grade Teacher x Seventh Grade Teacher	1	20.86	0.08	-0.04	0.70
Sixth Grade Teacher x Sixth Grade Teacher	1	39.18	3.25	-0.03	-0.96
Mother x Father	1	2.41	0.66	-0.004	-0.24
Mother x Seventh Grade Teacher	1	0.85	0.32	-0.005	-0.14
Mother x Sixth Grade Teacher	1	65.56	2.66	-0.04	-1.24
Father x Seventh Grade Teacher	1	16.42	0.78	0.03	0.62
Father x Sixth Grade Teacher	1	14.81	0.36	0.01	0.59
Seventh Grade Teacher x Sixth Grade Teacher	1	0.17	0.004	-0.003	-0.06
Regression Intercept				7.59	0.41

teacher's mathematics attitude, the interaction of measures of mother's and father's attitudes, and the square of father's attitude measure.

Student Ratings of Adult Attitudes and Student Feelings About Math Self Ratings

The relationship between student perceptions of adult mathematics attitudes and student self ratings on the Feelings About Math scale were analyzed by the computation of coefficients of correlation, multiple regression analysis, and the calculation of coefficients of contingency.

Coefficients in Correlation. Coefficients of correlation between student self ratings on the Feelings About Math scale and student ratings of the mathematics attitudes of each adult group were computed. These coefficients of correlation are presented in Table 25.

For the whole sample, three correlation coefficients were significant at the .01 level. These were the correlations between student self ratings and student perception ratings of mother's attitude, father's attitude, and seventh grade teacher's attitude.

The correlation between girls' self ratings and their ratings of mother's attitude was significant at the .01 level; the correlation between boys' self ratings and their ratings of mother's attitude was not statistically significant.

For boys, the correlation between self ratings and ratings of father's attitude was significant at the .01 level. For girls, this correlation was not statistically significant.

For boys, the correlation between self ratings and the ratings of seventh grade teacher's attitude approached significance ($p < .10$). For girls, this correlation was significant at the .05 level.

Table 25

Correlations Between Student Self Ratings of Mathematics Attitude and Student Ratings of the Mathematics Attitudes of Parents and Teachers

Student Sex	Number of Respondents	Correlation
	Mothers	
Male	64	.030
Female	67	.361**
Total	131	.228**
	Fathers	
Male	57	.360**
Female	63	.136
Total	120	.227**
	Seventh Grade Mathematics Teachers	
Male	62	.232≠
Female	65	.265*
Total	127	.249**
	Sixth Grade Teachers	
Male	61	-.027
Female	62	.015
Total	123	-.006

**Significant at the .01 level.

*Significant at the .05 level.

≠Approaching significance ($p < .10$).

Correlations between student self ratings and student ratings of sixth grade teacher's attitude were not statistically significant.

Coefficients of Contingency. The relation of student self ratings and student ratings of adult respondents was analyzed by the construction of contingency tables. Complete data were available from 108 students for this analysis.

For the tables, student self ratings were divided at the median. Ratings of adult mathematics attitudes were pooled and divided at the median. Table entries plotted student self ratings above or below the median against the number of adults rated above the median by the student. Three contingency tables were constructed: one for boys (Table 26); one for girls (Table 27); one for all students (Table 28).

Coefficients of contingency were computed and tested by the calculation of chi-square. For boys, the coefficient of contingency, .404, was significant at the .01 level. The coefficient of contingency for girls, .366, was significant at the .05 level. The overall coefficient of contingency was .335, significant at the .01 level.

Mathematics Attitude Scale Scores and Student Grades in Mathematics

To analyze the relationship between mathematics attitude scale scores and student success in mathematics coefficients of correlation were computed. In addition multiple regression analysis was performed.

Coefficients of Correlation. For all available data, coefficients of correlation between the mathematics attitude scale scores of students and student grades in mathematics were computed overall and by sex (Table 29). For 70 boys, the correlation of attitude scores and

mathematics grades was .505. For 73 girls, the correlation obtained was .558. For all 143 students, the correlation was .523. The correlation coefficients were significant at the .01 level.

Table 26

Comparison of Boys' Self Ratings from Feelings About Math Scale with Number of Parents and Teachers Rated Above the Median in Mathematics Attitude

	3 or 4 Adults Rated Above Median	2 Adults Rated Above Median	0 or 1 Adult Rated Above Median	Total
Student Self Rating Above Median	16	7	5	28
Student Self Rating Below Median	4	10	12	26
Total	20	17	17	54

Contingency Coefficient C = .4041
df = 2 $X^2 = 10.5393$**
**Significant at .01 level.

Table 27

Comparison of Girls' Self Ratings from Feelings About Math Scale with Number of Parents and Teachers Rated Above the Median in Mathematics Attitude

	3 or 4 Adults Rated Above Median	2 Adults Rated Above Median	0 or 1 Adult Rated Above Median	Total
Student Self Rating Above Median	15	8	2	25
Student Self Rating Below Median	13	4	12	29
Total	28	12	14	54

Contingency Coefficient C = .3661
df = 2 $X^2 = 8.3590$*
*Significant at .05 level.

Table 28

Comparison of Self Ratings from Feelings About Math Scale for All Students with Number of Parents and Teachers Rated Above the Median in Mathematics Attitude

Student Self Rating	Number of Adults Rated Above Median				
	4	3	2	0 or 1	Total
Above Median	15	16	15	7	53
Below Median	7	10	14	24	55
Total	22	26	29	31	108

Contingency Coefficient C = .3345.
df = 3 X^2 = 13.6070**

*Significant at .05 level.

**Significant at .01 level.

Table 29

Correlation between Student Grades in Mathematics and Student Mathematics Attitude Scale Scores, by Sex

Student Sex	Number of Respondents	Coefficient of Correlation
Male	70	.505**
Female	73	.558**
Total	143	.524**

**Significant at .01 level.

Where attitude data from all adult respondents were available, coefficients of correlation between student mathematics grades and adult respondent mathematics attitude scale scores were computed by student sex and overall. These coefficients, shown in Table 30, were not statistically significant.

Table 30

Correlations between Student Grades in Mathematics and the Mathematics Attitude Scale Scores of Parents and Teachers, by Sex

Student Sex	Number of Respondents	Coefficient of Correlation between Student Grades in Mathematics Attitude Scale Scores of			
		Mothers	Fathers	Seventh Grade Mathematics Teachers	Sixth Grade Teachers
Male	37	-.049	.157	-.185	.206
Female	28	.292	.114	-.056	-.175
Total	65	.171	.136	-.137	.078

Regression Analysis. A multiple regression analysis was performed with student mathematics grade as dependent variable and, as independent variables, student sex, mathematics attitude scale scores of students, mothers, fathers, seventh grade mathematics teachers, sixth grade teachers, and the second order interactions of these scale scores. Data for 70 students were employed in this regression, the results of which are summarized in Table 31.

The value of R^2 obtained was .530, significant at the .01 level of confidence. Thus, about 53 percent of the variance in student mathematics grades was accounted for by the independent variables.

While the regression as a whole was statistically significant, few of the independent variables made significant contributions to the regression equation. The contribution of one variable, the square of mother's attitude scale score, was significant at the .01 level. The contribution of student attitude scale score approached significance

Table 31

Multiple Regression of Student Mathematics Grades on Student Sex, Student, Parent, and Teacher Mathematics Attitudes and the Second Order Interactions of These Attitudes

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F	R^2
Regression	21	346.29	16.49	2.58**	.530
Error	48	306.86	6.39		
Corrected Total	69	653.14			

Source of Variance	Degrees of Freedom	Partial Sum of Squares	F	Regression Coefficient	t
Student Sex	1	11.91	1.86	--	--
Mathematics Attitude of					
Student	1	18.79	2.94≠	1.78	1.71≠
Mother	1	11.08	1.73	.81	1.32
Father	1	2.08	0.33	.32	0.57
Seventh Grade Teacher	1	0.03	0.004	-0.11	-0.07
Sixth Grade Teacher	1	0.85	0.13	0.22	0.36
Interaction of					
Student x Student	1	3.44	0.54	0.006	0.73
Mother x Mother	1	51.44	8.05**	-0.01	-2.83**
Father x Father	1	0.17	0.03	-0.0005	-0.16
Seventh Grade Teacher x Seventh Grade Teacher	1	9.74	1.52	0.02	1.23
Sixth Grade Teacher x Sixth Grade Teacher	1	3.30	0.52	-0.003	-0.72
Student x Mother	1	2.46	0.39	-0.003	-0.62
Student x Father	1	0.30	0.05	0.001	0.21
Student x Seventh Grade Teacher	1	15.76	2.47	-0.03	-1.57
Student x Sixth Grade Teacher	1	19.35	3.03≠	-0.01	-1.74≠
Mother x Father	1	0.13	0.02	0.0006	0.14
Mother x Seventh Grade Teacher	1	8.51	1.33	-0.01	-1.15
Mother x Sixth Grade Teacher	1	16.96	2.65	0.01	1.62
Father x Seventh Grade Teacher	1	3.67	0.57	-0.007	-0.76
Father x Sixth Grade Teacher	1	0.08	0.01	0.0007	0.11
Seventh Grade Teacher x Sixth Grade Teacher	1	0.69	0.11	-0.003	-0.33
Regression Intercept				-31.64	-0.62

**Significant at .01 level.
≠Approaching significance ($p < .10$).

($p < .10$) as did the interaction of student attitude scale score and sixth grade teacher's attitude scale score.

Variables with positive coefficients in the regression equation were the attitude scale scores of students (1.78), mothers (0.81), fathers (0.32), sixth grade teachers (0.22), the square of seventh grade teachers' attitude (0.02), the interaction of attitude scale scores of mothers and sixth grade teachers (0.01), the square of student attitude scale scores (0.006), and the interactions of mathematics attitude scale scores of students and fathers (0.001), fathers and sixth grade teachers (0.0007), and mothers and fathers (0.0006). Negative coefficients in the regression equation were assigned to the mathematics attitude scale scores of seventh grade teachers (-0.11), the interaction of student and seventh grade teacher attitude scores (-0.03), the square of mothers' attitude scale scores (-0.01), the interactions of attitude scale scores of students and sixth grade teachers (-0.01), mothers and seventh grade teachers (-0.01), sixth and seventh grade teachers (-0.003), the square of sixth grade teacher attitude scores (-0.003), the interaction of attitude scores of students and mothers (-0.003), and the square of fathers' attitude scale scores (-0.0005).

Student Ratings of Mathematics Attitudes and Student Grades in Mathematics

The relationship between student perceptions of mathematics attitudes and student success in mathematics was analyzed by the computation of correlation coefficients, multiple regression analysis, and the calculation of coefficients of contingency.

Coefficients of Correlation. Coefficients of correlation between student self ratings on the Feelings About Math scale and student grades in mathematics were computed overall and by sex (Table 32). For the 70 boys for whom data were available, the correlation was .365. The correlation for 72 girls was .445. For the whole sample, the correlation was .393. These coefficients of correlation were significant at the .01 level.

Table 32

Correlation between Student Grades in Mathematics and Student Self Ratings on Feelings About Math Scale

Student Sex	Number of Respondents	Coefficient of Correlation
Male	70	.365**
Female	72	.445**
Total	142	.393**

**Significant at the .01 level.

For 108 students, rating data for all adults were available. Using these data, correlation coefficients between student mathematics grades and student ratings of the mathematics attitudes of each adult were computed overall and by sex. These correlations are shown in Table 33. None were statistically significant.

Coefficients of Contingency. Student grades were divided at the median. Contingency tables were prepared which plotted student grade above or below the median against the number of attitude ratings above the overall rating median. These contingency tables are presented in Tables 34, 35, and 36.

Table 33

Correlation between Student Grades in Mathematics and Student Ratings of the Mathematics Attitudes of Parents and Teachers

Student Sex	Number of Respondents	Coefficient of Correlation between Student Grades in Mathematics and Student Ratings of Mathematics Attitudes of: Mothers	Fathers	Seventh Grade Mathematics Teacher	Sixth Grade Teacher
Male	54	-.097	.012	.093	-.084
Female	54	.151	.068	.190	.150
Total	108	.010	.040	.148	.129

Table 34

Comparison of Boys' Grades in Mathematics with Number of Mathematics Attitude Ratings Above the Median

Student Grade in Mathematics	Number of Attitude Ratings Above the Median: 4 or 5	2 or 3	0 or 1	Total
Above the Median	9	12	5	26
Below the Median	10	10	8	28
Total	19	22	13	54

Contingency Coefficient C = .1249
df = 2 X^2 = .8560

Contingency coefficients were computed and tested for significance by the calculation of chi-square. These coefficients of contingency, shown in Table 32, were not statistically significant.

Regression Analysis. A multiple regression analysis was performed in which student mathematics grade was the dependent variable and

independent variables were student sex, student ratings of the mathematics attitudes of students, mothers, fathers, seventh grade mathematics teachers, sixth grade teachers, and the second order interactions of these ratings. Data for 109 students were available for the regression. The results of the analysis are summarized in Table 37.

Table 35

Comparison of Girls' Grades in Mathematics with Number of Mathematics Attitude Ratings Above the Median

Student Grade in Mathematics	Number of Attitude Ratings Above the Median			
	4 or 5	2 or 3	0 or 1	Total
Above the Median	13	13	5	31
Below the Median	6	10	7	23
Total	19	23	12	54

Contingency Coefficient C = .0385
df = 2 X^2 = 2.1640

Table 36

Comparison of All Student Grades in Mathematics with Number of Mathematics Attitude Ratings Above the Median

Student Grade in Mathematics	Number of Attitude Ratings Above the Median					
	5	4	3	2	1 or 0	Total
Above the Median	7	15	14	11	10	57
Below the Median	8	8	11	9	15	51
Total	15	23	25	20	25	108

Contingency Coefficient C = .1758
df = 4 X^2 = 3.444

Table 37

Multiple Regression of Student Mathematics Grades on Student Sex, Student Ratings of the Mathematics Attitudes of Students, Parents, and Teachers, and the Second Order Interactions of These Ratings

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F	R^2
Regression	21	371.64	17.70	2.15**	.341
Error	87	717.30	8.24		
Corrected Total	108	1088.94			

Source of Variance	Degrees of Freedom	Partial Sum of Squares	F	Regression Coefficient	t
Student Sex	1	19.13	2.32	--	--
Attitude Rating of					
Student	1	23.14	2.81≠	-0.82	-1.67≠
Mother	1	12.47	1.51	0.53	1.23
Father	1	26.77	3.25≠	0.83	1.80≠
Seventh Grade Teacher	1	1.82	0.22	-0.41	-0.47
Sixth Grade Teacher	1	15.90	1.93	0.69	1.39
Interaction of					
Student x Student	1	5.16	0.63	0.007	0.79
Mother x Mother	1	14.34	1.74	-0.01	-1.32
Father x Father	1	0.004	0.0005	0.003	0.02
Seventh Grade Teacher x Seventh Grade Teacher	1	1.30	0.16	0.01	0.40
Sixth Grade Teacher x Sixth Grade Teacher	1	14.19	1.72	-0.02	-1.31
Student x Mother	1	10.94	1.33	-0.01	-1.15
Student x Father	1	7.37	0.89	0.01	0.95
Student x Seventh Grade Teacher	1	17.94	2.18	0.03	1.48
Student x Sixth Grade Teacher	1	0.57	0.07	0.01	0.26
Mother x Father	1	0.003	0.0004	-0.0002	-0.02
Mother x Seventh Grade Teacher	1	3.40	0.41	0.01	0.64
Mother x Sixth Grade Teacher	1	9.25	1.122	-0.01	-1.06
Father x Seventh Grade Teacher	1	42.64	5.17*	-0.04	-2.27*
Father x Sixth Grade Teacher	1	3.26	0.40	-0.01	-0.63
Seventh Grade Teacher x Sixth Grade Teacher	1	3.18	0.39	0.01	0.62
Regression Intercept				-0.71	-0.09

*Significant at the .05 level.
≠Approaching significance ($p < .10$).
**Significant at the .01 level.

An R^2 of .341 was obtained. This value was significant at the .01 level, and indicated that 34.1 percent of the variance in student mathematics grades was accounted for by the independent variables.

None of the independent variables, however, made a contribution to the regression equation which was significant at the .01 level. The interaction of attitude ratings of fathers and seventh grade teachers was significant at the .05 level. Student self ratings and ratings of fathers approached significance ($p < .10$).

Variables with positive regression equation coefficients were ratings of the attitudes of fathers (0.83), sixth grade teachers (0.69), mothers (0.53), the interaction of student and seventh grade teacher ratings (0.03), the square of seventh grade teacher ratings (0.01), the interactions of ratings for students and fathers (0.01), students and sixth grade teachers (0.01), mothers and seventh grade teachers (0.01), sixth and seventh grade teachers (0.01), and the squares of ratings for students (0.007), and fathers (0.003). Variables with negative coefficients in the regression equation were ratings of the attitudes of students (-0.82), seventh grade teachers (-0.41), the interaction of fathers' and seventh grade teachers' ratings (-0.04), the squares of ratings for sixth grade teachers (-0.02) and mothers (-0.01), and the interactions of ratings for students and mothers (-0.01), mothers and sixth grade teachers (-0.01), fathers and sixth grade teachers (-0.01), and mothers and fathers (-0.0002).

Comparison of the Regressions of Student Mathematics Grades on Attitude Scores and Student Ratings of Attitudes. For the regression of student mathematics grades on mathematics attitude scale scores, R^2

was .530. For the regression of mathematics grades on student perceptions of attitudes, R^2 was .341. Both multiple correlations were significant at the .01 level.

None of the related independent variables were statistically significant in both regressions. Only student attitude measures approached significance ($p < .10$) in each regression analysis. The regression equation coefficient for student attitude was positive in the regression on attitude scale scores, however, and negative in the regression on attitude ratings.

Variables with positive coefficients in both regression equations were attitude measures for mother, father, and sixth grade teacher, the square of the attitude measure for the seventh grade teacher, and the interaction of attitude measures for student and father. Variables with negative coefficients in both regression equations were seventh grade teacher attitude measures, the squares of attitude measures for mothers and sixth grade teachers, and the interactions of attitude measures for father and seventh grade teacher, and for student and mother.

Chapter 5

SUMMARY AND CONCLUSIONS

SUMMARY

The purpose of the study was to examine relationships among parent and teacher attitudes toward mathematics, student perceptions of these attitudes, student attitudes toward mathematics, and student success in mathematics as measured by class marks. The seventh grade mathematics program in the public schools of East Baton Rouge Parish, Louisiana, during the 1975-1976 school year provided the setting of the study.

Instruments for the study were constructed by the writer. Two twelve item Likert-type mathematics attitude scales were prepared, one for students and one for adults. The scales were closely matched as to item content but differed in vocabulary and reading level. A second instrument for students, the Feelings About Math scale, was constructed to provide measures of student perceptions of their own mathematics attitudes and the mathematics attitudes of their parents, seventh grade mathematics teachers, and teachers of the previous year.

During the spring of 1976, instruments for the study were mailed to the parents of a randomly chosen sample of 364 seventh grade students enrolled in the public schools of East Baton Rouge Parish. Included in the mailing were adult attitude scales for each parent and both student instruments.

Completed instruments were returned by the parents of 145 students, 39.8 percent of the mailing sample. Comparison of the students for whom full or partial data were available with those of the original random sample indicated no significant differences with respect to sex, race, or distribution among parish schools.

School records were employed to determine class marks in seventh grade mathematics for student respondents and to identify their seventh grade mathematics teachers and sixth grade teachers. Copies of the adult mathematics attitude scale were forwarded to the teachers identified.

Of 51 seventh grade teachers, 46 (90.2 percent) returned completed attitude scales. Of 103 sixth grade teachers, 84 (81.6 percent) returned completed scales.

Answers to three groups of questions were sought in the study. Questions of the first group were concerned with the relation of student perceptions of mathematics attitudes to Likert scale measures of mathematics attitudes. Questions of the second group dealt with the relationship of student mathematics attitudes and the attitudes of parents and teachers. The relationship of student mathematics attitudes to student perceptions of adult attitudes was also considered in the questions of this group. The third set of questions was concerned with the relation of the mathematics attitudes of all respondent groups to student grades in mathematics and with the relation of student perceptions of mathematics attitudes to student grades in mathematics. For all questions possible differences due to student sex were investigated.

Wherever possible, maximum available data were utilized in answering the questions raised in the study. Considerable variation in

the amount of data available for different phases of the study was observed, however. Data loss was especially heavy for those phases requiring complete attitude scale data from adult respondents. This severe data loss could be attributed in large part to the high incidence of one parent families in the mailing sample. A comparison of the 70 students for whom complete attitude scale data were available and the whole student respondent group indicated that data loss was especially heavy among students with average or below average class marks in mathematics. Phases of the study restricted to a consideration of the responses of these 70 students yielded results which could not be generalized to the whole sample, but which might be considered descriptive of comparatively successful students from two parent homes.

Statistical tools employed in the study were the coefficients of correlation, coefficients of contingency, and multiple regression.

CONCLUSIONS

Within the context of the study the following conclusions seemed justified.

1. Internal consistency reliability coefficients for the instruments of the study were acceptable, ranging from .88 to .93.

2. The overall correlation of .815 between student mathematics attitude scale scores and student self ratings on the Feelings About Math scale indicated these instruments measured much the same construct. The two instruments differed in that the Feelings About Math scale contained items assessing willingness to help others with mathematics work, while the Likert-type scale did not include items of this type.

3. Although the girls of the study sample received higher mathematics grades than the boys, and mean attitude measures for boys exceeded those for girls, the differences were not statistically significant.

4. The mean of student grade point averages in seventh grade mathematics fell between the B and C grade levels. Thus, members of the student sample tended to be slightly above average in classroom success.

5. Half the student respondents reported favorable mathematics attitudes. About 11.1 percent indicated strongly negative feelings about mathematics. These results were confirmed by the data from both instruments measuring student mathematics attitudes.

6. For all adult respondent groups, mean mathematics attitude scale scores fell in an interval indicating positive mathematics attitudes. The attitudes of seventh grade mathematics teachers were significantly higher ($p < .01$) than those of all other adult respondent groups. The attitudes of fathers and sixth grade teachers did not differ significantly but were significantly higher ($p < .01$) than those of mothers.

7. The ranking of mean student ratings of mathematics attitudes of parents and teachers was identical to the ranking of attitude scale means for the adult respondent groups. Students tended, however, to underrate the attitudes of seventh grade teachers and overrate the attitudes of other adults.

8. There was no significant relation between student ratings of the mathematics attitudes of sixth and seventh grade teachers and the attitude scale scores of the teachers.

9. The correlation of student ratings of the mathematics attitudes of mothers and the attitude scale scores of mothers was positive

and significant ($p < .01$; $r = .570$). The correlation was higher for boys of the sample than for girls but the difference in correlations was not significant.

10. The correlation of student ratings of the mathematics attitudes of fathers and fathers' attitude scale scores was positive and significant ($p < .01$; $r = .615$). The correlation was significantly higher ($p < .05$) for girls of the sample than for boys.

11. No significant relationships were found between the mathematics attitude scale scores of boys in the sample and the attitude scale scores of any adult respondent group. The correlations between girls' attitude scale scores and the attitude scale scores of both mothers and seventh grade teachers were small but approached significance ($p < .10$). For girls and seventh grade teachers the correlation was negative; for girls and mothers the correlation was positive. Overall, the correlation of student attitude scale scores and those of mothers was small but positive and significant ($p < .05$; $r = .174$). No other whole sample correlations between student and adult attitude scale scores approached significance.

12. Student sex, parent and teacher mathematics attitudes and second order interactions of these attitudes were not significant predictors of student mathematics attitudes for that part of the sample for which complete attitude data was available ($n = 70$).

13. For a larger part of the sample ($n = 130$), multiple regression of student mathematics attitudes on student sex, mathematics attitudes of mothers and seventh grade teachers and the interaction of these attitudes approached significance ($p < .10$). Of the independent variables for the regression, seventh grade teacher's attitude was

significant ($p < .05$); mother's attitude and the interaction of attitudes approached significance ($p < .10$); student sex was not significant. In the regression equation, the mathematics attitudes of mother and seventh grade teacher tended to decrease predicted values of student attitude, while their interaction tended to increase predicted values.

14. Among the correlations of student mathematics attitude scale scores and student ratings of the attitudes of parents and teachers, the following results were noted. The relation between boys' attitudes and their ratings of father's attitude approached significance ($p < .10$). The relation between girls' attitudes and their ratings of mother's attitude approached significance ($p < .10$). For all students the relation of student attitudes and the ratings of seventh grade teacher attitude was small but significant ($p < .05$; $r = .179$). No other correlations between student attitudes and student ratings of mathematics of adult attitudes were significant.

15. For the part of the sample for which complete student rating data were available ($n = 108$), student sex, student ratings of parent and teacher attitudes, and the second order interactions of these ratings were *not* significant predictors of student mathematics attitude scale scores.

16. While neither regression for the prediction of student attitudes on attitude measures for all adults was statistically significant, certain related variables contributed in the same way to each equation. In both regression equations, positive coefficients were assigned to father's attitude measure, the interaction of father's and seventh grade teacher's attitude measures, and the square of mother's attitude measure. Negative coefficients were assigned in both equations to seventh grade

teacher's attitude measure, the square of father's attitude measure, and the interaction of father's and mother's attitude measures.

17. The following results were noted among the correlations of student self ratings on the Feelings About Math scale and student ratings of the mathematics attitudes of parents and teachers. Significant at the .01 level were the correlations between boys' self ratings and ratings of the attitudes of fathers, girls' self ratings and ratings of the attitudes of mothers, all students' self ratings and attitude ratings for each parent and the seventh grade teacher. The correlation between girls' self ratings and ratings of the attitudes of seventh grade teachers was significant at the .05 level; the corresponding correlation for boys approached significance ($p < .10$). No other significant correlations were observed.

18. Student attitudes toward mathematics measured by the Feelings About Math scale were significantly related to the number of parents and teachers perceived as having highly positive mathematics attitudes. The overall coefficient of contingency and the coefficient of contingency for boys were significant at the .01 level. The coefficient of contingency for girls was significant at the .05 level.

19. Student grades in mathematics and student mathematics attitude scale scores were significantly related ($p < .01$) overall ($r = .524$), for boys ($r = .505$), and for girls ($r = .558$).

20. For the part of the sample for which complete attitude scale data were available, no significant correlations between student mathematics grades and mathematics attitude scores for parents and teachers were obtained.

21. About 53.0 percent of the variance in student mathematics grades was accounted for by student sex, mathematics attitude scale scores of students, parents, teachers, and the second order interactions of these scores. While the multiple regression was significant ($p < .01$), few of the independent variables contributed significantly to the prediction of student grades. The square of mother's attitude was significant at the .01 level. Student attitude and the interaction of student and sixth grade teacher's attitudes approached significance ($p < .10$).

22. Student grades in mathematics and student self ratings on the Feelings About Math scale were significantly related ($p < .01$) overall ($r = .393$), for boys ($r = .365$), and for girls ($r = .445$).

23. Student grades in mathematics were not significantly related to the number of highly positive attitude ratings of student, parents, and teachers given by the student.

24. For the part of the sample for which complete student attitude ratings were available, about 34.1 percent of the variance in student mathematics grades was accounted for by student sex, student attitude ratings of student, parents, teachers, and the second order interactions of these ratings. The multiple regression was significant ($p < .01$) but, again, few of the independent variables contributed significantly to the prediction of student grades. The interaction of attitude ratings for father and seventh grade teacher was significant to the .01 level. Student self ratings and ratings of father approached significance ($p < .10$).

25. In both regression equations for the prediction of student mathematics grades, positive coefficients were assigned to attitude

measures of mother, father, and sixth grade teacher, the square of seventh grade teacher attitude measures, and the interaction of student and father's attitude measures. In both equations, negative coefficients were assigned to seventh grade teacher attitude measures, the squares of attitude measures for mother and sixth grade teacher, the interaction of student and mother's attitude measure, and the interaction of father's and seventh grade teacher's attitude measures.

The conclusions of the study may be summarized as follows. For the seventh grade students of the sample no significant sex differences with respect to mathematics attitudes or classroom success in mathematics were observed. Overall, both boys and girls in the sample exhibited positive mathematics attitudes and slightly above average mathematics grades.

Among adult respondents, the mathematics attitudes of seventh grade teachers were significantly higher than those of other adults; the mathematics attitudes of mothers, significantly lower. The mathematics attitudes of sixth grade teachers were in general higher than those of fathers, but not significantly so. In general student ratings of adult mathematics attitudes followed the same ranking pattern.

Student ratings of the mathematics attitudes of parents were significantly related to the mathematics attitude scores of parents. There was no relation between student ratings of teacher attitudes and scale measures of these attitudes. Thus, student ratings of adult mathematics attitudes indicated that, in general, students could assess parent attitudes with considerable accuracy but had little direct insight into teacher attitudes.

Student mathematics attitudes tended to be more positively related to the attitudes of the mother than to those of the father. This relationship tended to be stronger for girls than for boys in the sample.

Student ratings of parent attitudes were significantly and positively related to student mathematics attitudes. The relationship tended to be stronger between student attitudes and ratings for the parent of the same sex.

Student mathematics attitudes tended to be negatively related to the attitudes of the seventh grade mathematics teacher. This relationship approached significance for the girls of the sample. The relationship of student mathematics attitudes and student ratings of the attitudes of seventh grade mathematics teachers, however, tended on the whole to be positive and significant.

Student attitudes, sixth grade teachers' attitudes, and student ratings of these attitudes were essentially unrelated.

For those students of the sample for which complete attitude data were available, parent and teacher mathematics attitudes and their interactions were not significant predictors of student mathematics attitudes. For a larger part of the sample, the prediction of student attitudes from attitude measures for mothers and seventh grade teachers and their interaction approached significance. The attitudes of mothers and seventh grade teachers were negatively related to student attitudes; the interaction effect was positive.

Student ratings of parent and teacher mathematics attitudes and their interactions were not significant predictors of student mathematics

attitudes. The number of adults rated as having highly positive mathematics attitudes was significantly related to student mathematics attitudes, however.

Scale measures of mathematics attitudes and their interactions accounted significantly for about 53.0 percent of the variance in student mathematics grades. Student ratings of mathematics attitudes and their interactions accounted significantly for about 34.1 of the variance in student mathematics grades. Few of the independent variables in either regression were statistically significant. In both regressions, however, measures of the attitudes of father, mother, and sixth grade teacher, the square of the seventh grade teacher's attitude measure, and the interaction of student and father's attitude measure were positively related to student mathematics grade. Negatively related to student mathematics grade in both regressions were seventh grade teacher's attitude measures, the interaction of father's and seventh grade teacher's attitude measures, the squares of attitude measures of mother and sixth grade teacher, and the interaction of student and mother's attitude measures.

RECOMMENDATIONS

On the basis of the present study, the following recommendations for further research are made.

1. Further study of the measurement and interpretation of student perception of parent and teacher mathematics attitudes is needed. Instruments for the study of these perceptions should be refined and extended.

2. Additional studies are required to clarify the relationships of student mathematics attitudes and achievement and the attitudes of parents and teachers. More comprehensive attitude measures reflecting a variety of attitude factors should be employed in such studies.

3. Studies similar to the present study should be carried out with students of varying age levels.

4. Attention should be given to the effects of varying student ability levels on relationships between mathematics attitudes and achievement.

5. The effects of varying types of personal relationship between student and parent, student and teacher should be similarly considered.

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APPENDICES

East Baton Rouge Parish School Board

P. O. BOX 2850

Baton Rouge, Louisiana 70821

PH. (504) 926-2790

February 26, 1976

Dear Parents,

As Supervisor of Mathematics for East Baton Rouge Parish schools, I have read and approved the outline of Mr. Johnson's research study. The study will be carried out in accordance with guidelines set up by the parish staff to ensure that the rights of individuals and schools involved are protected.

If successfully completed, the study will provide useful information concerning the relationship of attitudes and student success in mathematics. For this reason, I urge you to participate in the study.

Sincerely yours,

Ann Tinsley

Ann Tinsley,
Supervisor of Mathematics

AT:plp

APPROVED:

E. George Thom

E. George Thom
Coordinator, Elementary Schools

Henry L. Essex

Henry L. Essex
Junior High School Coordinator

Graydon L. Walker

Graydon L. Walker
High School Coordinator

APPENDIX B

ATTITUDE TOWARD MATHEMATICS
Scale for Adults

Completed by:

____Mother
____Father
____Guardian (Female)
____Guardian (Male)

Each item of this opinionnaire is a statement expressing an emotional reaction or feeling towards mathematics. For each item, please circle the response which best indicates your agreement or disagreement with the statement as it applies to your own reaction to mathematics. When you read an item, you may strongly agree (SA) with it; you may agree (A) with it; you may be undecided (U) about your reaction to it; you may disagree (D) with it or strongly disagree (SD) with it.

SA A U D SD 1. When I was a student, I used to dread math classes.

SA A U D SD 2. I seem to have a mental block against mathematics which keeps me from working successfully with numbers and number relations.

SA A U D SD 3. The logic of mathematics has a strong appeal to me.

SA A U D SD 4. Having to work with mathematics makes me feel like a fish out of water.

SA A U D SD 5. I have always enjoyed being in math classes.

SA A U D SD 6. Having to concentrate on a math problem makes me nervous.

SA A U D SD 7. When presented with a math problem which is new to me, I am usually afraid I won't be able to work it out.

SA A U D SD 8. The study of mathematics has always been fun for me.

SA A U D SD 9. Just thinking about mathematics makes me feel uncomfortable and ill at ease.

SA A U D SD 10. I always feel inadequate when faced with work in mathematics.

SA A U D SD 11. My feelings about mathematics are positive and favorable to the subject.

SA A U D SD 12. When I am working with mathematics I feel confident and at ease.

APPENDIX C

ATTITUDE TOWARD MATHEMATICS
Scale for Adults

Each item of this opinionnaire is a statement expressing an emotional reaction or feeling towards mathematics. For each item, please circle the response which best indicates your agreement or disagreement with the statement as it applies to your own reaction to mathematics. When you read an item, you may strongly agree (SA) with it; you may agree (A) with it; you may be undecided (U) about your reaction to it; you may disagree (D) with it or strongly disagree (SD) with it.

SA A U D SD 1. When I was a student, I used to dread math classes.

SA A U D SD 2. I seem to have a mental block against mathematics which keeps me from working successfully with numbers and number relations.

SA A U D SD 3. The logic of mathematics has a strong appeal to me.

SA A U D SD 4. Having to work with mathematics makes me feel like a fish out of water.

SA A U D SD 5. I have always enjoyed being in math classes.

SA A U D SD 6. Having to concentrate on a math problem makes me nervous.

SA A U D SD 7. When presented with a math problem which is new to me, I am usually afraid I won't be able to work it out.

SA A U D SD 8. The study of mathematics has always been fun for me.

SA A U D SD 9. Just thinking about mathematics makes me feel uncomfortable and ill at ease.

SA A U D SD 10. I always feel inadequate when faced with work in mathematics.

SA A U D SD 11. My feelings about mathematics are positive and favorable to the subject.

SA A U D SD 12. When I am working with mathematics I feel confident and at ease.

APPENDIX D

ATTITUDE TOWARD MATHEMATICS
Scale for Students

The statements below describe feelings toward mathematics. For each item, please circle the response which gives your own feeling about the statement.

Agree	Undecided	Disagree	1.	I hate to go to math classes.
Agree	Undecided	Disagree	2.	My mind goes blank when I try to do math.
Agree	Undecided	Disagree	3.	I like math because it makes sense to me.
Agree	Undecided	Disagree	4.	Having to do math makes me feel like a fish out of water.
Agree	Undecided	Disagree	5.	I enjoy being in math class.
Agree	Undecided	Disagree	6.	When I have to think hard about a math problem, it makes me nervous.
Agree	Undecided	Disagree	7.	When I get a new kind of math problem, I'm usually afraid I won't be able to work it out.
Agree	Undecided	Disagree	8.	Math has always been fun for me.
Agree	Undecided	Disagree	9.	Just thinking about math makes me uncomfortable and ill at ease.
Agree	Undecided	Disagree	10.	When working math, I never feel successful.
Agree	Undecided	Disagree	11.	I like mathematics.
Agree	Undecided	Disagree	12.	I feel confident and comfortable when doing math.

APPENDIX E

FEELINGS ABOUT MATH
Scale for Students

Some people like math. They enjoy working with numbers and solving tricky problems. Others don't like the subject. Math makes them feel uncomfortable and they try to keep away from it if they can.

In the column at the left below, there are statements which tell how people may act or feel when working with math. The other columns are for people you know. First there is a column for YOU. Read each statement. If you agree the statement tells how you act or feel, put a + sign in your column by the statement. If you think the statement is not true for you, put a - sign in your column by the statement. Put a 0 in the column by the statement if you can't decide if it is true or false for you.

When you have finished your own column, fill in the columns for others. To yourself, think how these people act or feel. Mark the spaces the same way you did for your column. Put a + sign by statements that tell how you think the person acts or feels; put a - sign by statements that are wrong for the person. Put an 0 if you can't decide on an answer.

Ways of Acting	You	Your Mother	Your Father	Your Math Teacher	Your Teacher Last Year
1. Does not enjoy number work.					
2. Helps others with math work willingly.					
3. Avoids working math when possible.					
4. Likes to work with numbers.					
5. Answers questions about math quickly and easily.					
6. Enjoys solving math problems.					
7. Is comfortable and at ease when working with numbers.					
8. Finds it hard to work with numbers.					
9. Thinks working with numbers is fun.					
10. Does not like to help others with math work.					
11. Does not like to solve problems					
12. Is nervous and ill at ease when working math problems.					

APPENDIX F

To Whom It May Concern:

As parent and/or legal guardian of_____,
enrolled as a seventh grade student at _____,
East Baton Rouge Parish, Louisiana, I grant permission to Guy W. Johnson to examine the records of the aforesaid student maintained at the aforesaid school for the following purposes:

1. to determine nine-weeks grades in seventh grade mathematics earned by the student during the first, second, and third grade periods of the 1975-76 school year;
2. to identify the mathematics teacher of the student during the 1975-76 school year; and
3. to identify the student's teacher during the 1974-75 school year.

I understand that all information received by Mr. Johnson will be treated as confidential and that no individuals will be named in the completed report of his research.

_____
Signature

_____
Date

VITA

Guy W. Johnson was born on December 28, 1931 in Tampa, Florida. Following graduation from Hillsborough High School in Tampa, he attended Florida State University, receiving the B. A. (1953) and M. S. (1960) degrees in Mathematics.

Mr. Johnson has taught mathematics in elementary and secondary schools and at the college level. During the spring of 1975, he served as a senior researcher on the staff of the Governor's Education Study Committee, Baton Rouge, Louisiana. He is presently employed as a mathematics teacher at Baton Rouge High School.

He is married to the former Vivian Joyce Campbell of Tampa, Florida and is the father of Cynthia Frances and Pressley Martin Johnson.

EXAMINATION AND THESIS REPORT

Candidate: Guy W. Johnson

Major Field: Education

Title of Thesis: A STUDY OF COGNITIVE AND ATTITUDINAL INTERACTIONS IN SEVENTH GRADE MATHEMATICS

Approved:

Dan Adams
Major Professor and Chairman

James D. Traynham
Dean of the Graduate School

EXAMINING COMMITTEE:

B. F. Bellon

Fred M. Smith

J. H. Fairley

Barbara M. Strawitz

L. I. Nash

Date of Examination:

November 17, 1976